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National Survey of Pesticides in Drinking Water

Stanford Research Inst, Menlo Park, Calif

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Final Report

NATIONAL SURVEY OF PESTICIDES IN DRINKING WATER

Prepared for:

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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June 30, 1976

Final Report

NATIONAL SURVEY OF PESTICIDES IN DRINKING WATER

By: Elizabeth M. McCarthy

Prepared for:

ENVIRONMENTAL PROTECTION AGENCY
Chemistry Branch (WH-568)
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I SUMMARY

More than 700 samples of raw and finished drinking water were analyzed for the presence of aldrin, dieldrin, DDT, and DDT metabolites. Thirty samples were also analyzed for the presence of heptachlor, heptachlor epoxide, and γ chlordane. Minimum detection levels were: for dieldrin, 4 ppt; for heptachlor epoxide and chlordane, 5 ppt; for aldrin, DDT and DDT metabolites, and heptachlor, 10 ppt. At these levels of detection, 107 water samples were found to contain dieldrin, 4 contained aldrin and dieldrin, 6 contained dieldrin and DDT, and 2 contained DDT. No samples were found to contain heptachlor, heptachlor epoxide, or γ chlordane at or above the minimum levels of detection.

During the program, it became apparent that compounds other than the pesticides of interest were also present in the sample extracts, so the program was expanded to include identification of some of these unknown contaminants by gas chromatography/mass spectrometry. We obtained complete mass spectra of dieldrin from each of two samples, but were unsuccessful in our attempt to obtain a satisfactory mass spectral pattern of DDT in a third sample. In addition to dieldrin, we identified the following compounds in a few selected water samples:

Anthracene or phenanthrene
Atrazine
Butyl phthalyl butyl glycolate
Dibutyl phthalate
Diethyl phthalate
Dioctyl phthalate
Trichloronaphthalene
Tetrachloronaphthalene
Pentachloronaphthalene
Triphenyl phosphate

II INTRODUCTION AND BACKGROUND

The main objective of this study was to determine the ambient levels of aldrin, dieldrin, DDT, and DDT metabolites in drinking water collected from Puerto Rico and all fifty of the United States. These results will provide the Environmental Protection Agency with a reliable data base for these pesticides in drinking water supplies throughout the United States. This study was needed because available data on concentrations in drinking water had been collected sporadically and were related in distribution geographically to interstate carrier water supplies. Limits of detection of our methods of analysis have also been reduced in the past few years, increasing sensitivity from the parts per billion level to the parts per trillion level.

The concentrated water extracts were screened by electrolytic conductivity gas chromatography for halogen-containing compounds (except fluorides). Limits of detection were 4 ppt dieldrin and 10 ppt aldrin, DDT, and DDT metabolites. For all samples that appeared to contain the pesticides at these levels or higher, the results were confirmed by gas chromatography/mass spectrometry (gc/ms) by use of mass fragmentation methodology. The gas chromatographic screening tests indicated that other halogenated compounds were present in addition to the pesticides being sought. The initial program, therefore, was expanded to include the analysis of 30 selected samples for the presence of heptachlor, heptachlor epoxide, and γ chlordane by gc/ms mass fragmentation. Minimum detectable levels were 10 ppt for heptachlor and 5 ppt for heptachlor epoxide and γ chlordane. Two other tasks were also added to the program. The first of these was to attempt to obtain a complete mass spectrum of at least one of the three pesticides (aldrin, dieldrin, DDT) in three different samples. The second was to attempt to identify some of the unknown constituents present in the extracts by gc/ms.

III METHODOLOGY

A. Sample Preparation and Gas Chromatographic Screening

The main objective of this program was to analyze water for aldrin, dieldrin, DDT, and DDT metabolites. The water samples were extracted with 15% dichloromethane in hexane, concentrated, cleaned up by elution of the concentrate from Florisil, with the use of 15% diethyl ether in petroleum ether as the eluting solution, and concentrated to 250-350 µl. This method of extraction and cleanup is outlined in Methods for Organochlorine Pesticides in Industrial Effluents, published in the Federal Register, 38, No. 75, Pt. II. All extraction and elution reagents were nanograde quality and each new lot was examined before use for the presence of contaminants. Contaminants were removed from sodium sulfate by boiling 3 times for 10 minutes each in 15% dichloromethane/hexane. Each lot was then checked for contamination. Each new batch of Florisil used in the cleanup procedure was checked for pesticide recovery before use.

A Microtek Model 220 gas chromatograph equipped with a Coulson electrolytic conductivity detector in the halogen mode was used for the preliminary screening tests. An aliquot of the extract equivalent to about 100 g of water was injected into the gas chromatograph for these determinations. The gas chromatographic conditions used for the first 132 samples were:

Column packing: 5% OV-17 on 80/100 mesh Chromosorb W DMCS
4-ft x 1/8-in. I.D.

Injection port: 225°C

Column temperature: 170-250°C @ 7°/min

Transfer line temperature: 235°C

Carrier gas and flow rate: He, 45 ml/min

Vent open: 4 min

For the remaining 583 extracts, gas chromatographic conditions were changed slightly:

Column packing: 5% SE-30 on 80/100 mesh Chromosorb W DMCS
4-ft x 1/8-in. I.D.

Injection port: 220 °C

Column temperature: 150-220 °C @ 5 °/min

Transfer line temperature: 235 °C

Carrier gas and flow rate: He, 45 ml/min

Vent open: 3 min

These changes enabled us to lower the minimum detection level of DDT from 20 ppt to 10 ppt. Calculations were done by comparing the peak height of the unknown with the peak height of the appropriate pesticide standard. Samples and standards were alternately injected throughout the day as a check on instrument behavior and linearity.

The extracts of those samples that appeared to contain aldrin, dieldrin, DDT, and DDT metabolites at or above 10, 4, 10, and 10 ppt, respectively, were confirmed by gc/ms mass fragmentation. The remaining extract of each sample was transferred to a glass ampul, which was then sealed and stored under refrigeration. These extracts were used for the heptachlor, heptachlor epoxide, γ chlordane analyses and for the complete mass spectral studies.

B. Gas Chromatography/Mass Spectrometry

The instruments used for this work were a Finnigan Automated GC/MS Model 3200 equipped with a Finnigan Model 6100 Interactive Data System and an LKB 9000 GC/MS equipped with a PDP-12 computer and a CEC-21-110B high resolution, double focusing mass spectrometer. The LKB instrument was used for 128 of the aldrin, dieldrin, DDT analyses. The Finnigan instrument was used for the remaining 230 of these analyses, the thirty heptachlor, heptachlor epoxide, and γ chlordane analyses, and the complete mass spectral studies.

1. Mass Fragmentography

The mass fragmentography technique was used for the confirmatory analyses for aldrin, dieldrin, DDT, and DDT metabolites and for the heptachlor, heptachlor epoxide, and γ chlordane analyses. In this type of analysis, mass numbers are preselected for monitoring so that a complete mass spectrum need not be scanned. The fragment ions selected must have a reasonable intensity and be characteristic of the compound under study. The data for these ions are plotted to yield "selected ion current profiles" or "mass fragmentograms." A judicious choice of ions can reduce the interference from possible contaminants with the same retention time. There is very little chance that two different compounds have the same gas chromatographic retention time and correspond at the same time to preselected fragments with identical peak ratios.

For the determination of aldrin and dieldrin, we chose m/e^+ 261 and 263, because these are two of the more intense peaks of the mass spectra of both these compounds. For the same reason, we selected m/e^+ 235 and 237 for DDT and DDD and m/e^+ 246 and 248 for DDE. On the gc columns used, DDE and dieldrin have the same retention time. DDE, therefore, was monitored only when we found a significantly lower result for dieldrin by gc/ms than by gc alone. The m/e^+ values chosen for heptachlor were 272 and 274; for heptachlor epoxide, 355; and for γ chlordane, 373. Ortho-terphenyl was added as an internal standard to 280 of the aldrin, dieldrin, and DDT samples and to all the heptachlor, heptachlor epoxide, and chlordane samples, so as to determine the amount of water represented by the aliquot of the extract used for analysis. Figures 1-8 present mass fragmentograms and spectral patterns for the several pesticides in this study.

Concentration calculations were based on a comparison of peak areas obtained from the sample with peak areas obtained from standards. Either of the two masses monitored for a compound can be used, and should give the same result. If they do not, the smaller result is used to give an upper concentration limit, since there is obvious interference at the other mass.

Gas chromatographic conditions for the LKB 9000 were:

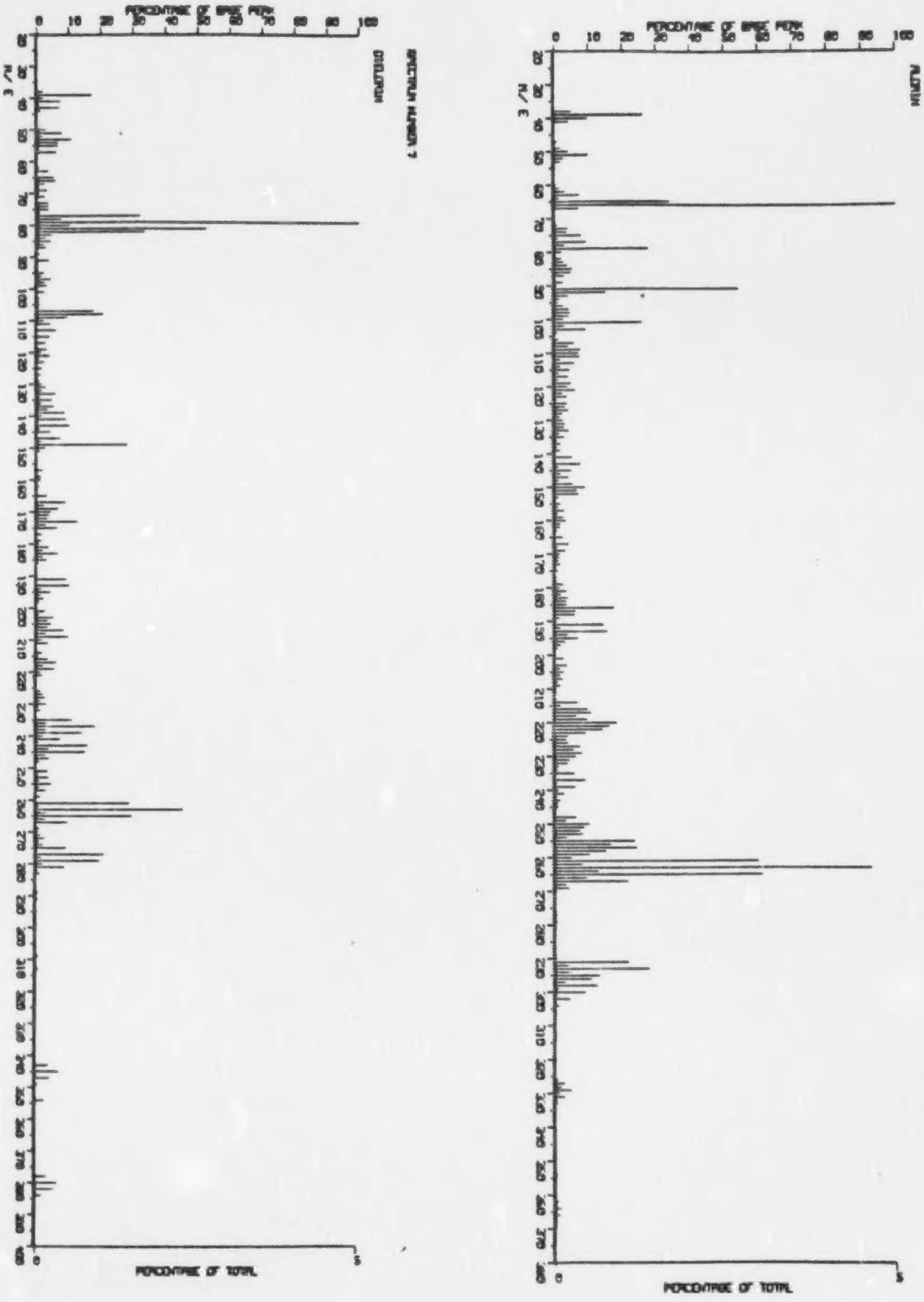
Column packing: 3% OV-1 on 80/100 mesh Chromosorb W DMCS
5-ft x 2-mm I.D.

Injection port: 250°C

Column temperature: 130-230°C @ 10°/min

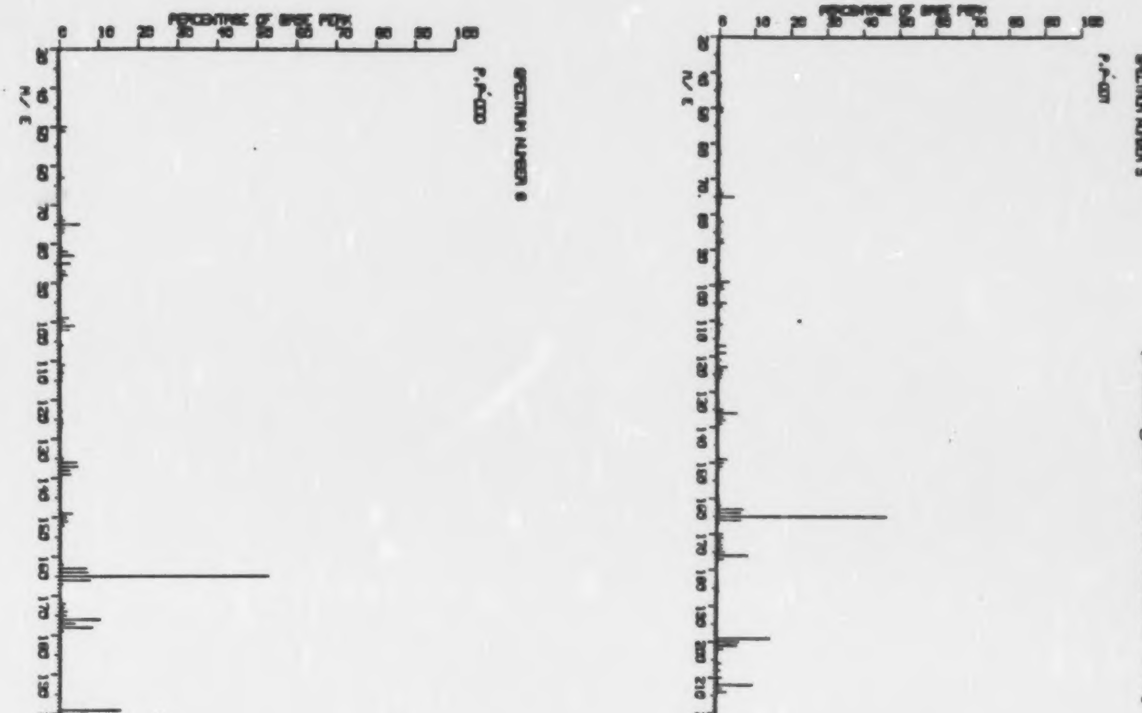
Separator and transfer line temperature: 250°C

Carrier gas and flow rate: He, 30 ml/min



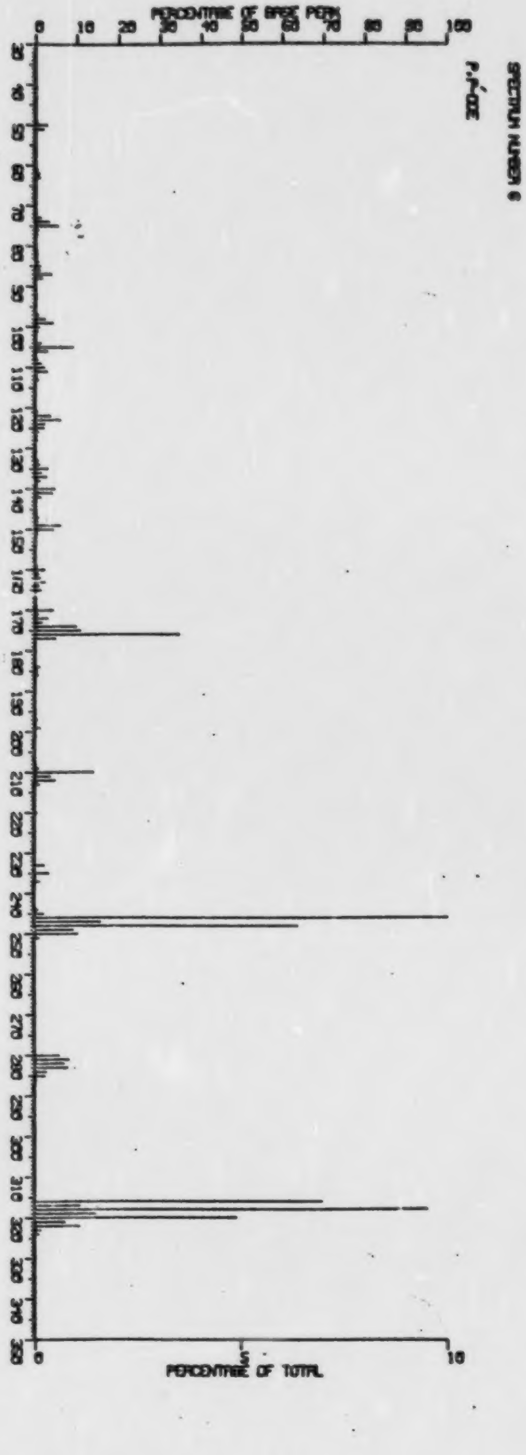
(Finnigan Instruments Corp.)

Figure 1 Mass Spectra of Aldrin and Dieldrin



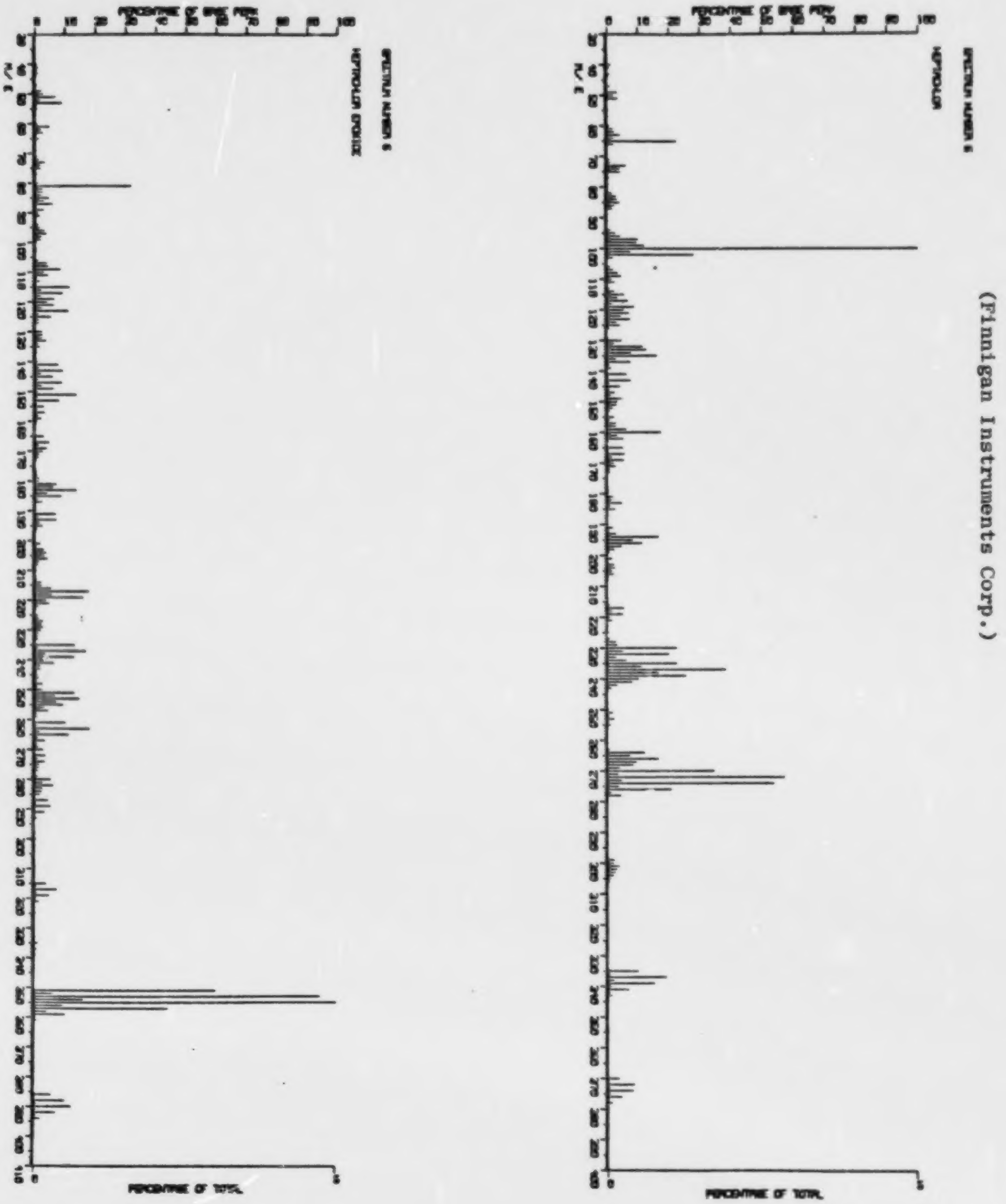
(Finnigan Instruments Corp.)

Figure 2 Mass Spectra of p,p'-DDT and p,p'-DDD



(Finnigan Instruments Corp.)

Figure 3 Mass Spectrum of p,p'-DDE



(Finnigan Instruments Corp.)

Figure 4 Mass Spectra of Heptachlor and Heptachlor Epoxide

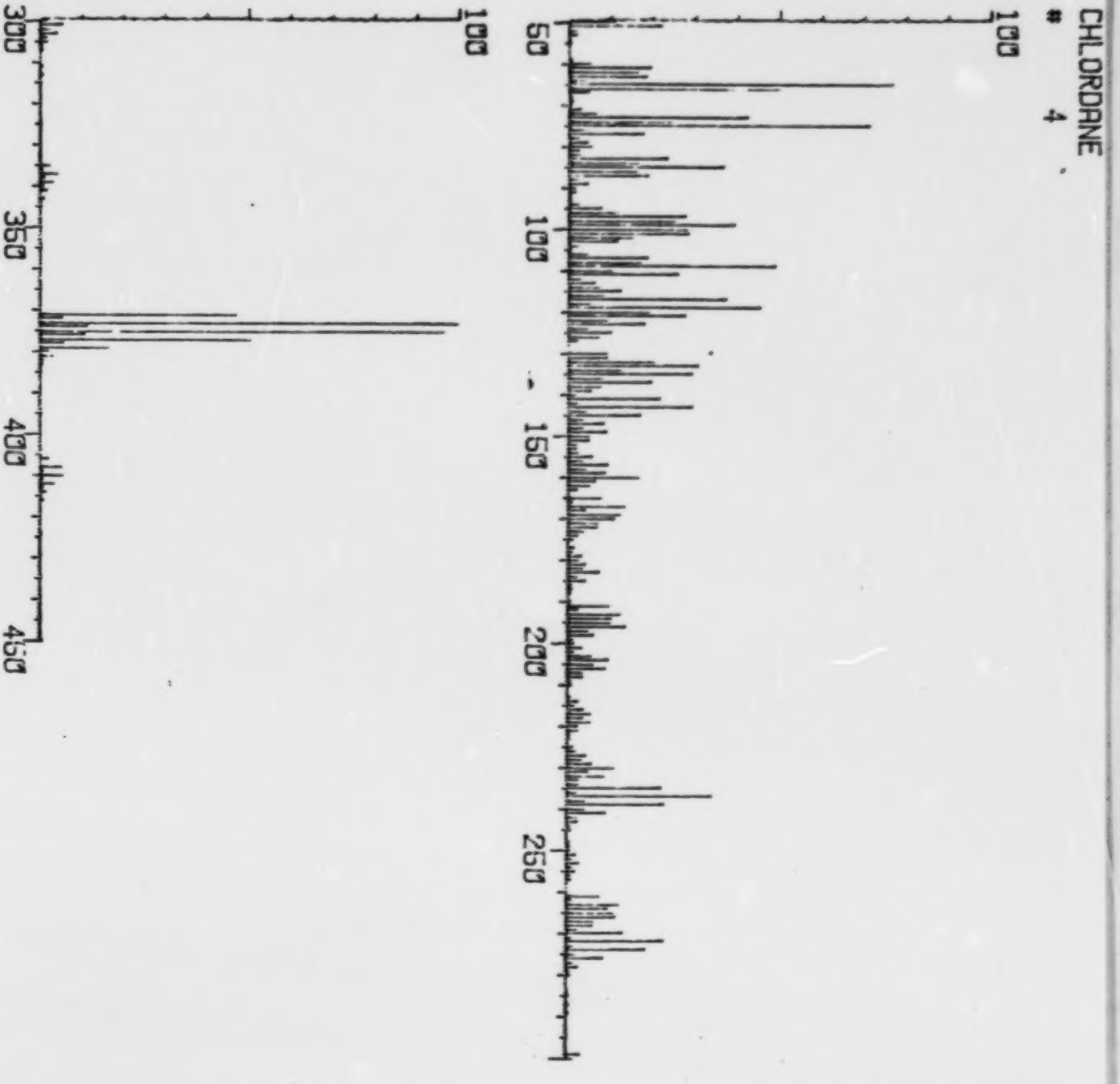


Figure 5 Mass Spectrum of Chlordane

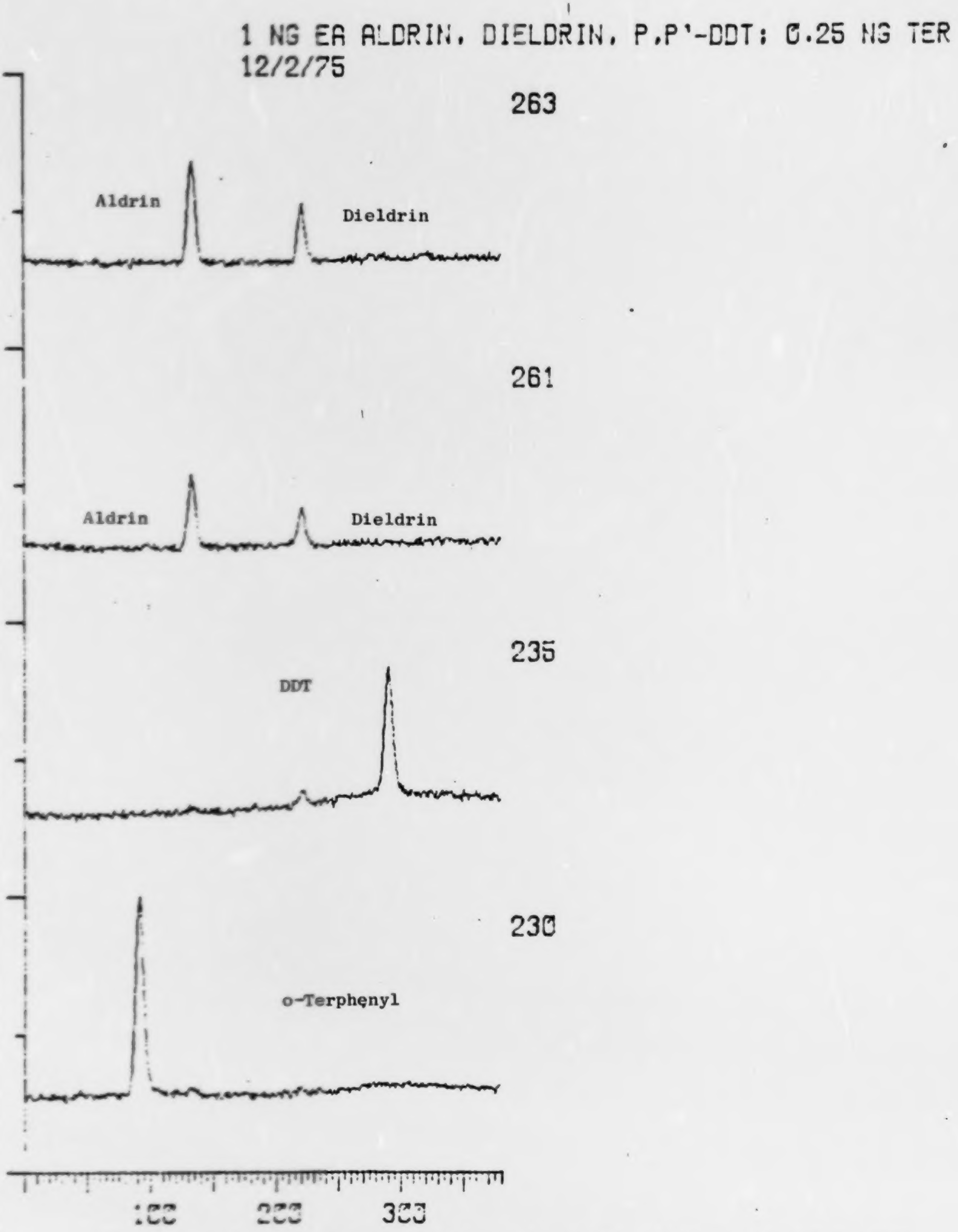


Figure 6 Mass Fragmentograms of Aldrin, Dieldrin, p,p'-DDT, and o-Terphenyl

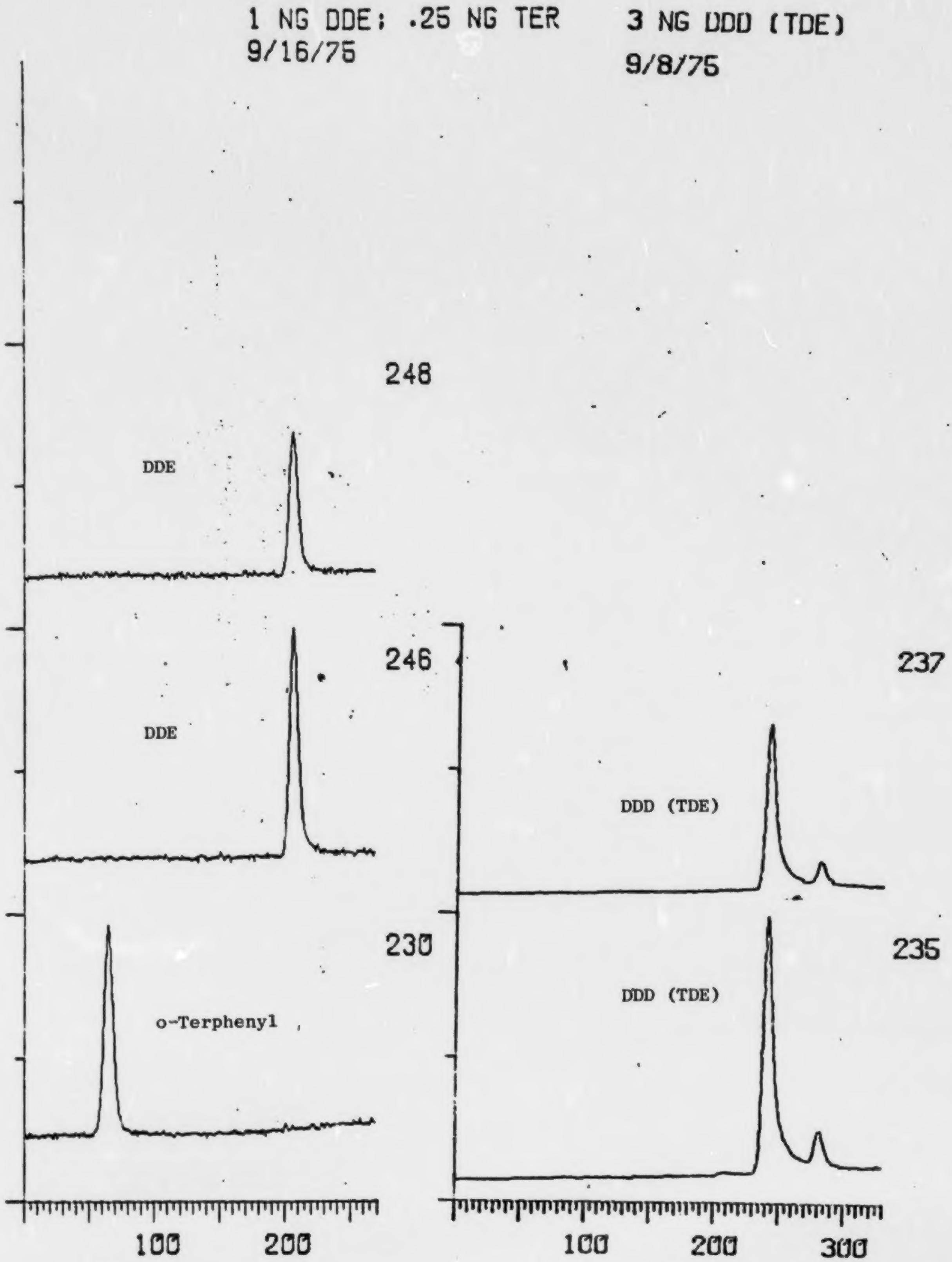


Figure 7 Mass Fragmentograms of DDE, DDD, and o-Terphenyl

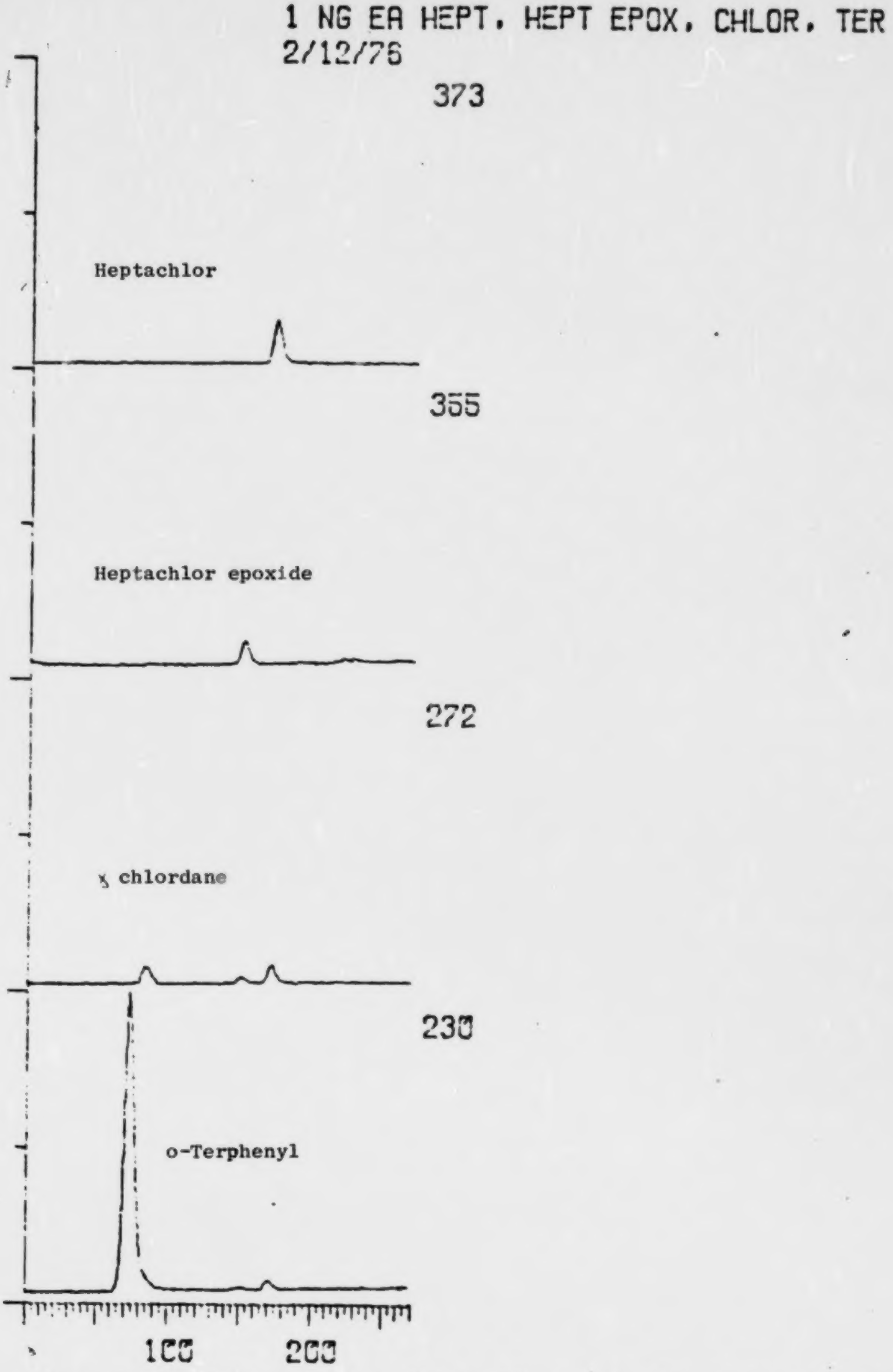


Figure 8 Mass Fragmentograms of Heptachlor, Heptachlor Epoxide, γ Chlordane and o-Terphenyl

Conditions for the Finnigan Model 3200 GC/MS were:

Column packing: 3% OV-1 on 80/100 mesh Chromosorb W DMCS
5-ft x 1/8-in. I.D.

Injection port: 225°C

Column temperature: 140-220°C @ 12°/min

Separator and transfer line temperature: 220°C

Carrier gas and flow rate: He, 22 ml/min

2. Complete mass spectral analysis

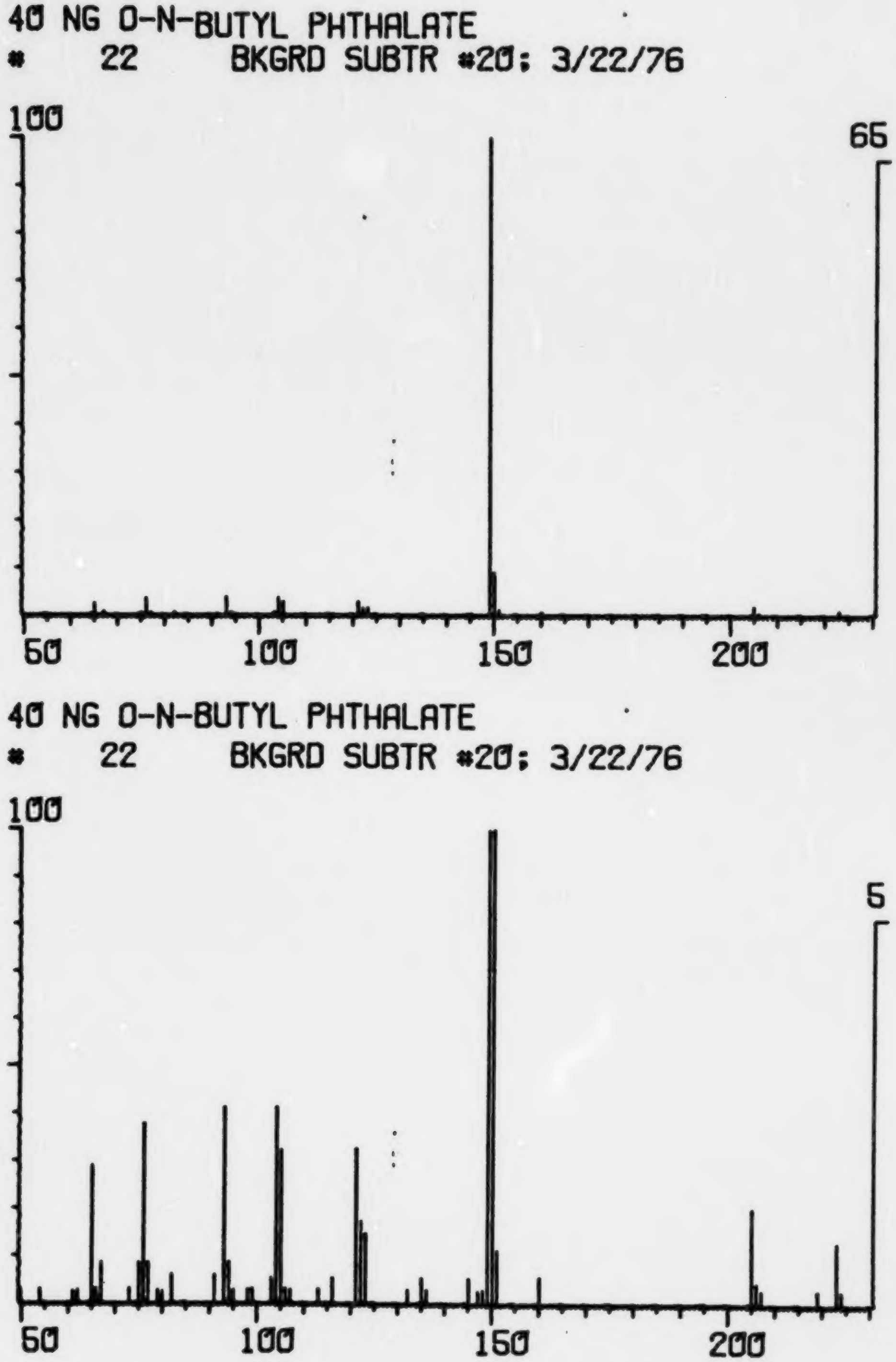
For these analyses, we used two different techniques: One was to inject the total remaining sample directly into the gc/ms; the other was to collect the gas chromatographic elution fraction of interest from a micropreparative column. The collected material was dissolved in hexane and the resulting hexane solution injected into the gc/ms (described more completely below). It was hoped that this second approach would eliminate interference in mass spectral data caused by contributions from extraneous background material present in the extracts and from tailing of compounds that elute nearby.

A 5% OV-17 column was used in the gc/ms analysis of all samples (except sample 22504), because the separation properties of the OV-17 are slightly different from the SE-30 column used for collection, and thus sometimes aids in separating overlapping peaks. The column temperature program was generally 180-220°C @ 12°/min but could be altered to achieve optimum separation conditions for the expected retention time span of the unknown compounds in the sample.

The sample was introduced into the inlet of the gas chromatograph. After the solvent peak was eluted from the column, venting was discontinued and the ionizer of the mass spectrometer was set to scan m/e^+ of 50 to 450 in 2 seconds. The accumulated total ion current from each scan over this range was plotted against time on an x-y plotter to give the ion current gas chromatogram. This plot is very similar to a gas chromatogram obtained by FID. Individual spectra are identified by the sample number. Beneath the sample number is the spectrum number taken from the ion current chromatogram. The spectrum number is followed by a "BKGRD SUBTR # ___." This background spectrum is located near the spectrum of interest and is subtracted from it to remove interferences from instrument background, tailing of nearby compounds, and background material contributed by the sample itself. The water extracts show a very high background level, which makes it difficult to obtain a spectrum that matches a standard perfectly. The spectrum number and the background spectrum subtracted from it are chosen to give the clearest spectrum possible, but in most cases, there will be extra and/or missing peaks, especially with m/e^+ below 100 where the highest background occurs.

The spectra are printed to show all m/e^+ values as clearly as possible. To some spectra, a multiplication factor is applied at all peak intensities above a certain m/e^+ value to enable us to see the peaks and their intensity ratios at the higher m/e^+ values, which might not otherwise be possible. This multiplication factor appears above the spectrum to which it is applied (for example, $> 200 \times 10$). Spectra may be normalized to a peak other than the base peak in cases where the base peak is many times larger than any other peak in the spectrum. Increasing the apparent intensities of weak peaks makes it easier to locate them and to compare their intensity ratios. For example, Figure 9 gives two spectra of dibutyl phthalate, one of which is normalized to a peak other than the base peak and the other is as it would otherwise appear. If a spectrum has been normalized to a peak other than the base peak, it is noted on the spectrum and the m/e^+ value used for normalization is also noted. The mass range in the printed ion current chromatograms was usually 100-450 amu instead of 50-450 amu, which was monitored. This eliminated the solvent peak tail and clarified greatly the peaks of interest in the chromatogram.

A spectrum representative of each peak in the ion current chromatogram was printed to identify the peaks that seemed most promising. To aid in identifying the unknowns, we have accessed the instrument's own library, which contains a pesticide file and the Mass Spectral Search System. We then manually compared our unknown spectrum with standard spectra from the library searches to confirm the identity of the chromatogram. The standard spectra used were from various sources, including SRI's file whenever possible; various literature sources, including books and current journals; the Finnigan Corporation; and spectra obtained from Dr. David Thomas of SRI's Mass Spectrometry Laboratory in the Life Sciences Division. In many cases, we could not identify the compound, perhaps because the spectrum is not found in either library, because it is badly distorted by extra peaks, missing peaks, or both, or because we have a mixture of compounds.



normalized to m/e 150

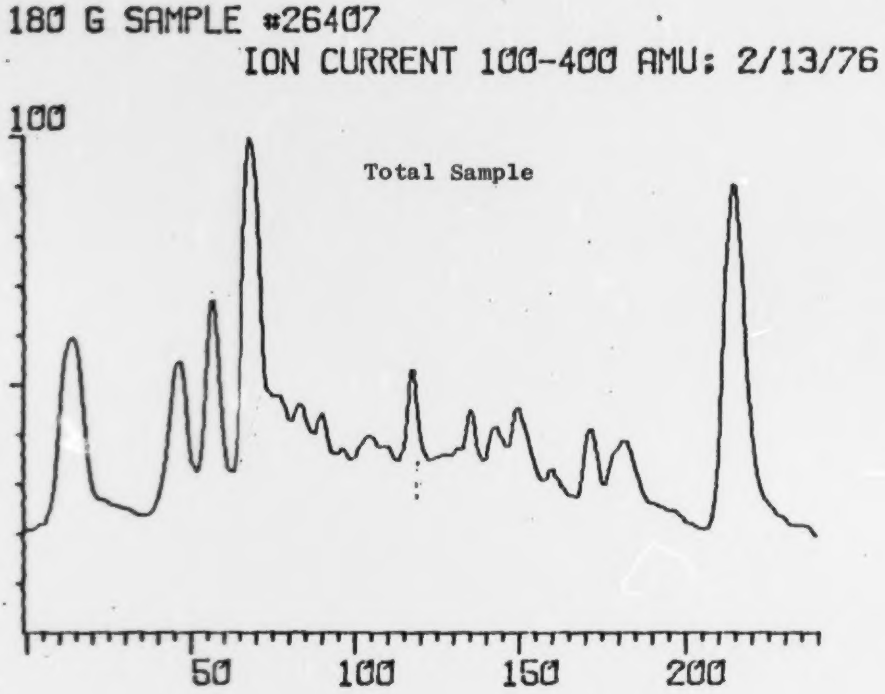
Figure 9 Dibutyl Phthalate

The analysis of a total sample as opposed to a fractionated one is more nearly complete because the total sample is injected into the gc/ms, as illustrated in the ion current chromatograms of the samples in which this technique was used (Figure 10). Despite the vast amount of information stored, a unique spectrum is difficult to obtain because of the distortion described above. Unknowns are identified by the same method used when analyzing collected fractions of samples. We also screened the ion current chromatogram for specific compounds or classes of compounds (such as chlorinated naphthalenes or phthalates) that we suspected were present in the sample; we instructed the data system to search the stored spectra for a specific ion or groups of ions characteristic of the compounds of interest. The occurrence and amplitude of the specific ions desired versus the spectrum number were plotted to give a mass fragmentogram and to locate the particular compounds on the ion current chromatogram.

C. Fraction Collection for Gas Chromatography/Mass Spectrometry

Fractions of samples were collected for gc/ms analysis by the procedure developed by G. C. Bassler[1] at SRI. The FID detector was removed from one of the column exit ports on a Microtek Model 220 gas chromatograph and replaced by the device shown in Figure 11. The samples are collected in a 1.6-1.8 mm O.D. by 100-mm long glass capillary tube that fits into the device (Figure 12). A 10-mm long glass wool plug is placed about 10 mm from the exit end of the capillary. To trap the material of interest, we cooled the capillary by wrapping it with 2¼-in.-wide aluminum foil filled with dry ice.

Samples could not be collected from the chromatographic column attached to the electrolytic conductivity detector used in our experiments. Therefore, two columns were used; one to determine retention times and one to collect samples. These columns were made at the same time so that retention times would correspond as closely as possible. First, the original gas chromatographic screening curve of the sample of interest was checked to determine the retention time of the unknown compounds. Next, a standard was chosen with a retention time close to that of the compound to be collected. At least two injections were made on the column connected to the electrolytic conductivity detector to establish a retention time span. Once this time was determined, several injections were made on the collection column with slight variations in the time of collection. When the collections were completed, 20 μl of hexane was added to the capillary through the glass wool plug. About 15 μl of hexane was added through the open end of the capillary and allowed to run down to the glass wool being careful to completely wet the walls.



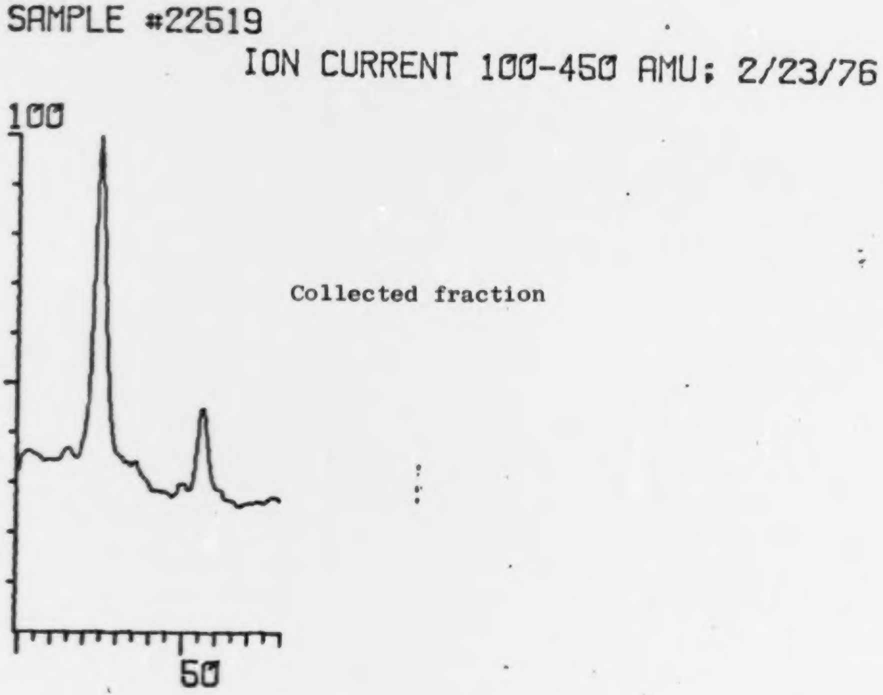


Figure 10 Ion Current Chromatograms

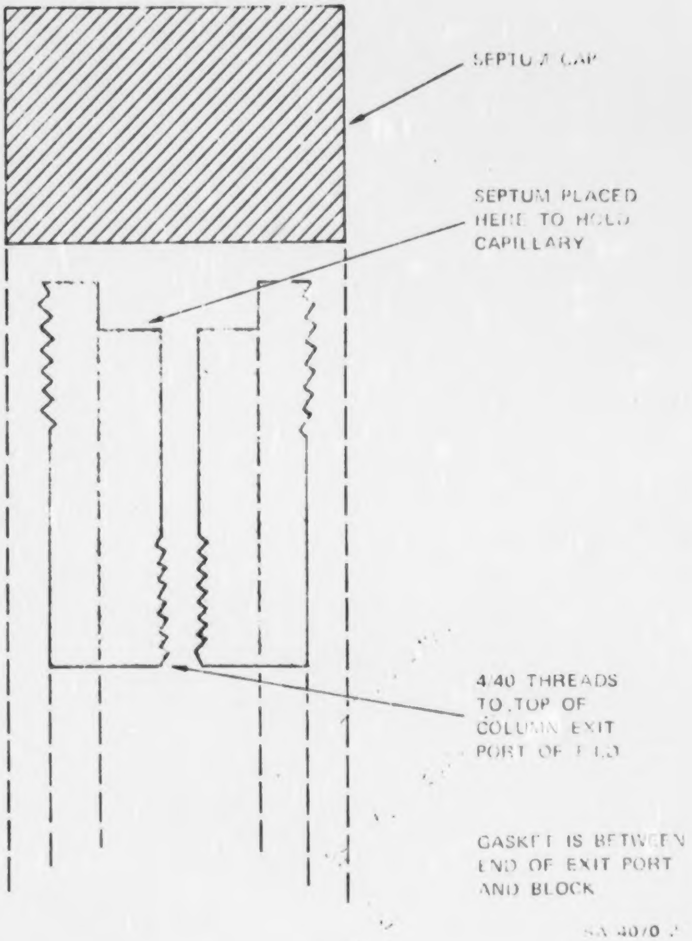
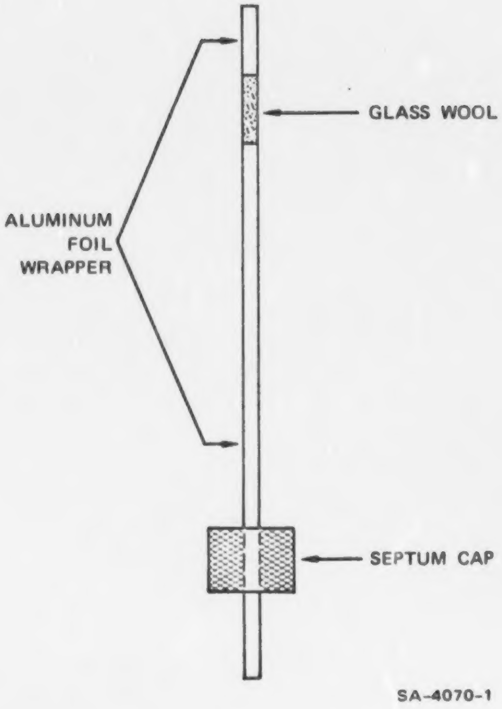

SEPTUM CAP
SEPTUM PLACED HERE TO HOLD CAPILLARY
4/40 THREADS TO TOP OF COLUMN EXIT PORT OF FID
GASKET IS BETWEEN END OF EXIT PORT AND BLOCK
SA 4070 2

Figure 11 Fraction Collection Device

Reproduced from best available copy.



GLASS WOOL
ALUMINUM FOIL WRAPPER
SEPTUM CAP
SA-4070-1

Figure 12 Capillary Collector

By use of a 50-μl syringe, the solvent was removed as completely as possible through the glass wool plug and injected onto the detector column to measure recovery efficiency so as to determine any differences between the two columns, and adjust the collection time accordingly for maximum collection efficiency (approximately 60% for the substances tested).

A small aliquot of the remaining sample extract was gas chromatographed using the electrolytic conductivity detector to determine retention time spans on the actual column that was to be used. The total remaining sample was injected into the fractionation column and the fractions collected. The collected fractions were dissolved in hexane, as described above, and the solution injected into the gc/ms.

D. Quantitation

1. Pesticides Analyses

These analyses have been described on page 3 (gas chromatographic screening) and page 4,5(mass fragmentography).

2. Complete Mass Spectral Analyses

Although this work was intended to be primarily qualitative, the results would be more useful if the concentration could be estimated. The minimum concentrations in Table I (page 32) are based on the equivalent amount of water injected into the gc/ms and 25 ng of contaminant as the minimum amount necessary to obtain a complete mass spectrum. Most samples undoubtedly contained more than the minimal amount. Each possible maximum figure is only a "best guess", based on the equivalent amount of water injected versus the size of the peak in the ion current chromatogram when visually compared with the ion current chromatogram for a known amount of a standard. The maximum values for atrazine were determined as described above, then multiplied by 5 to make the final calculations, since it is known that only approximately 20% will be eluted from a Florisil cleanup column with a solution of 15% diethyl ether in petroleum ether. The extraction method used is not optimum for triazine pesticides but we have no definitive data on efficiency.[2]

IV EXPERIMENTAL RESULTS

A. Pesticides

Of the 715 water samples analyzed, 119 were found to contain aldrin, dieldrin, and/or DDT and DDT metabolites at or above the minimum levels of detection (4 ppt for dieldrin, and 10 ppt for aldrin, DDT, and DDT metabolites). In 107 samples, dieldrin only was found, 4 samples contained aldrin and dieldrin, 6 contained dieldrin and DDT, and 2 contained DDT only. Of the 30 samples selected to be analyzed for heptachlor, heptachlor epoxide, and γchlordane, none contained these pesticides at or above the minimum levels of detection (5 ppt for heptachlor epoxide and γchlordane and 10 ppt for heptachlor). An Appendix to this report lists the results of water sample analyses for pesticides, and also includes copies of all positive gas chromatographic curves, a representative negative curve, and curves obtained from standards of varying concentrations.

B. Mass Spectral Analyses of Three Samples Containing High Residues

In the total survey, only Samples 26425, 26426, and 12523 had high enough levels of pesticide to be considered for this task.

These analyses were done on extracts of the duplicate water samples, because the extracts of the original samples were exhausted in the gas chromatographic screening and mass fragmentation confirmatory analyses.

1. Samples 26425 and 26426

The concentration of dieldrin in these samples was 63 and 56 ppt, respectively, and the samples contained 850 ml of water. Fractions of each were collected from the preparative gc column starting at 6 min and 45 sec after injection and ending 7 min and 25 sec after injection. With a 60% collection efficiency, the maximum amounts of dieldrin collected were 32 and 28 ng. Although identifiable, the spectra obtained at these minimal levels are barely above the signal-to-noise ratio. Figures 13-18 give collection curves and spectra, and Figure 19 shows a spectrum for a dieldrin standard.

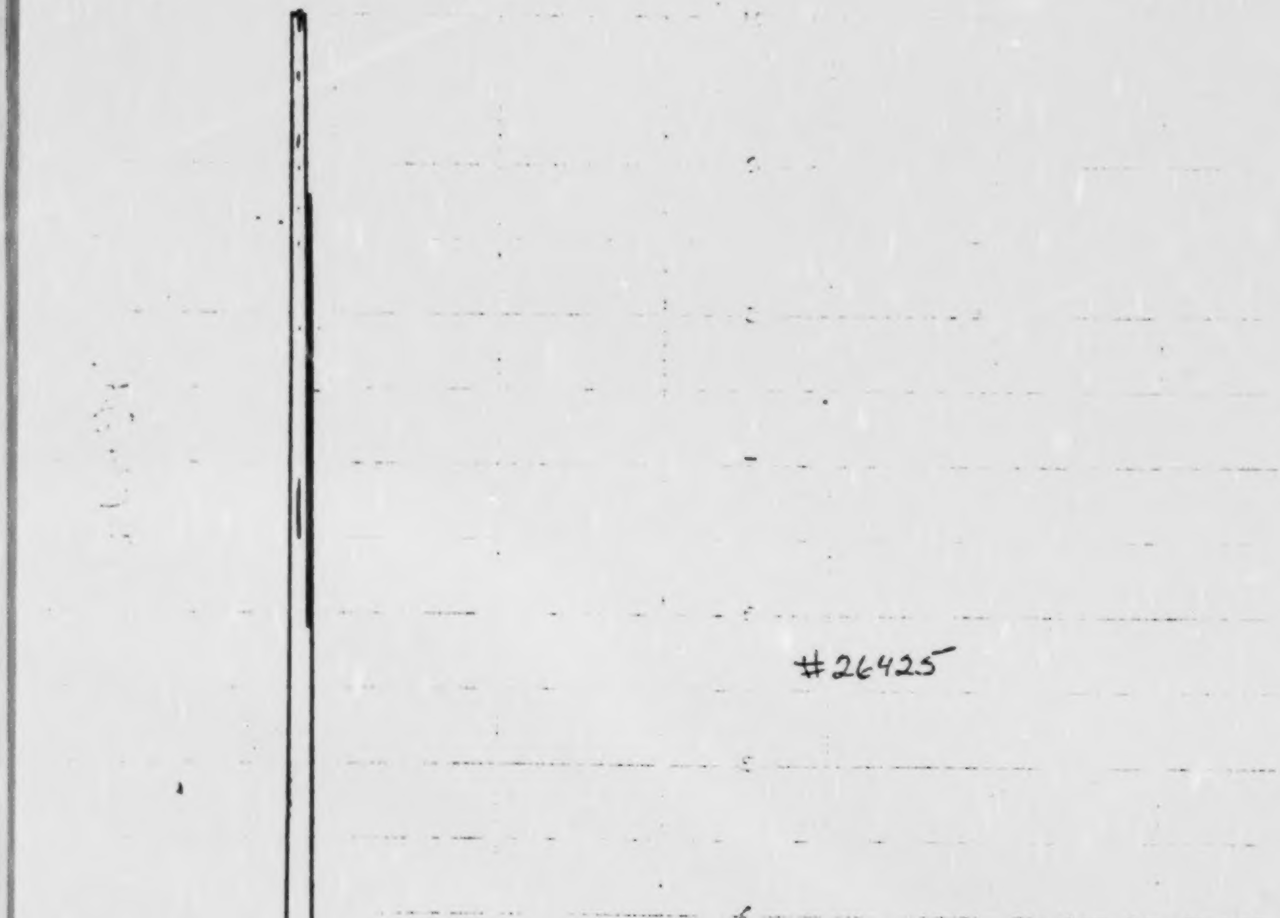


Figure 13 Fraction Collection Gas Chromatogram-Sample No. 26425

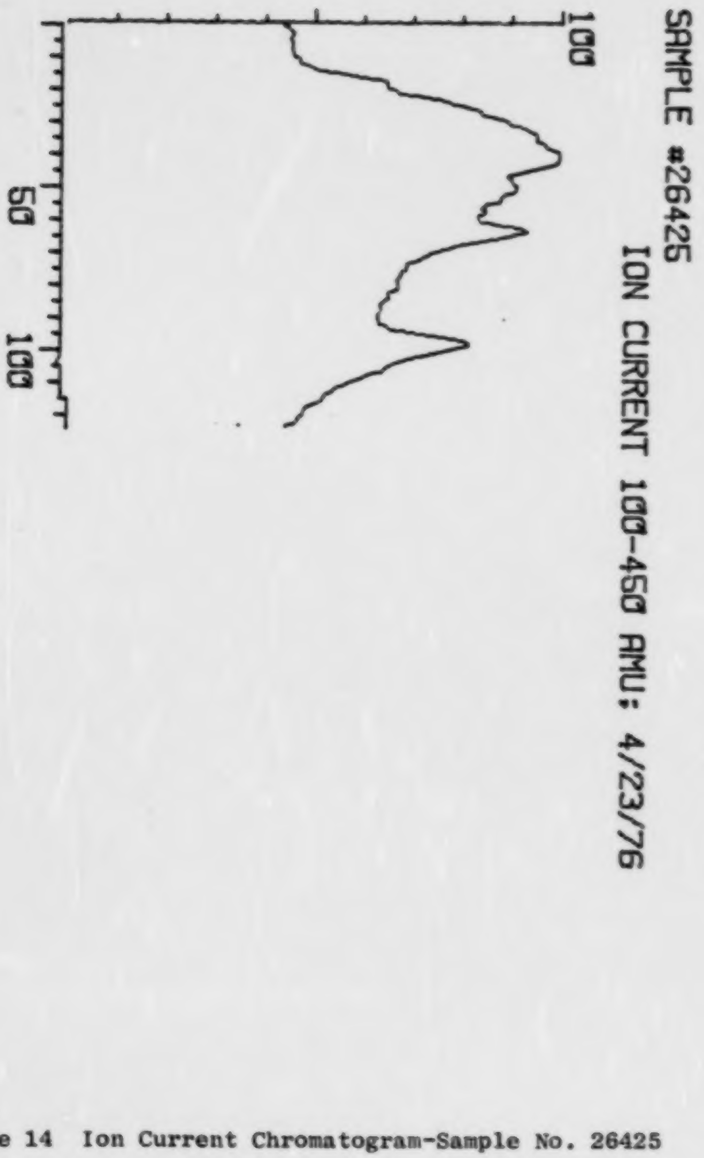
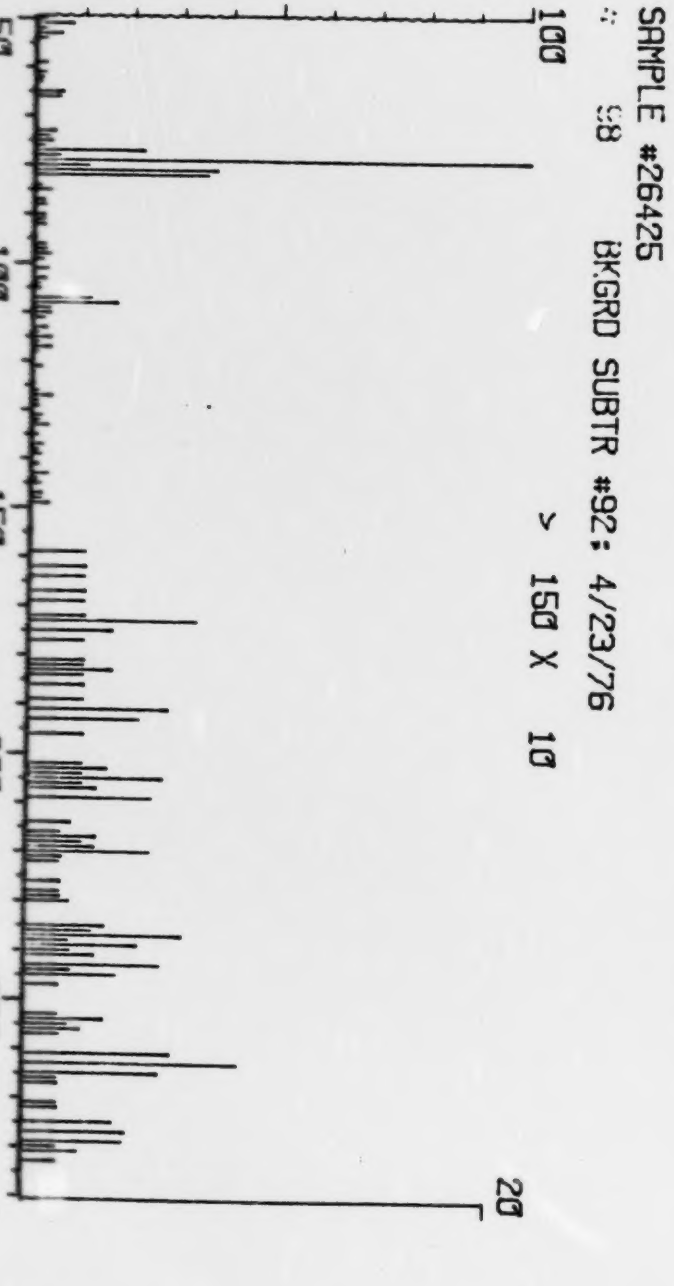


Figure 14 Ion Current Chromatogram-Sample No. 26425



Dieldrin

Retention time: 7.2 min

Figure 15 Mass Spectrum of Dieldrin from Sample No. 26425

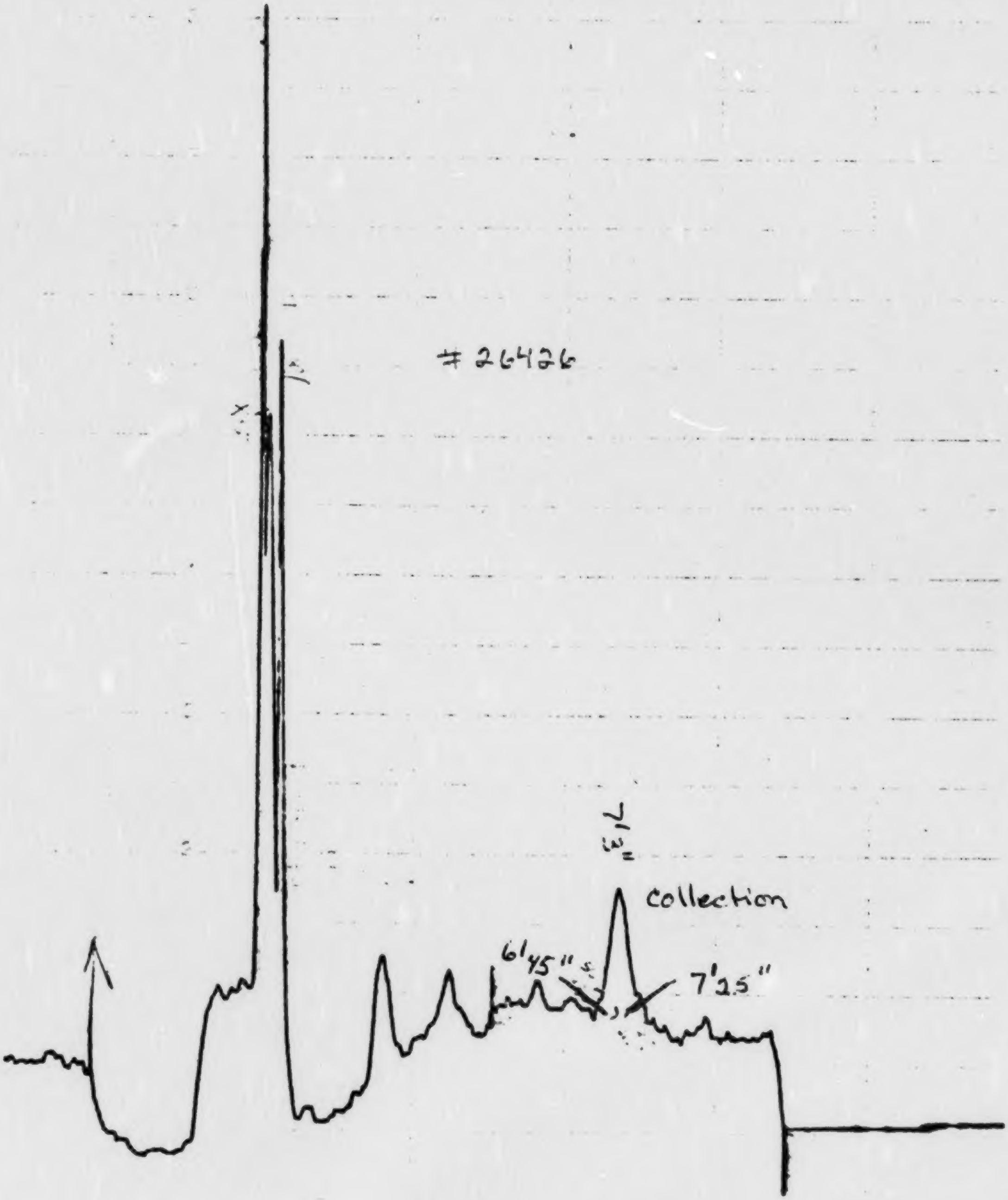


Figure 16 Fraction Collection Gas Chromatogram from Sample No. 26426

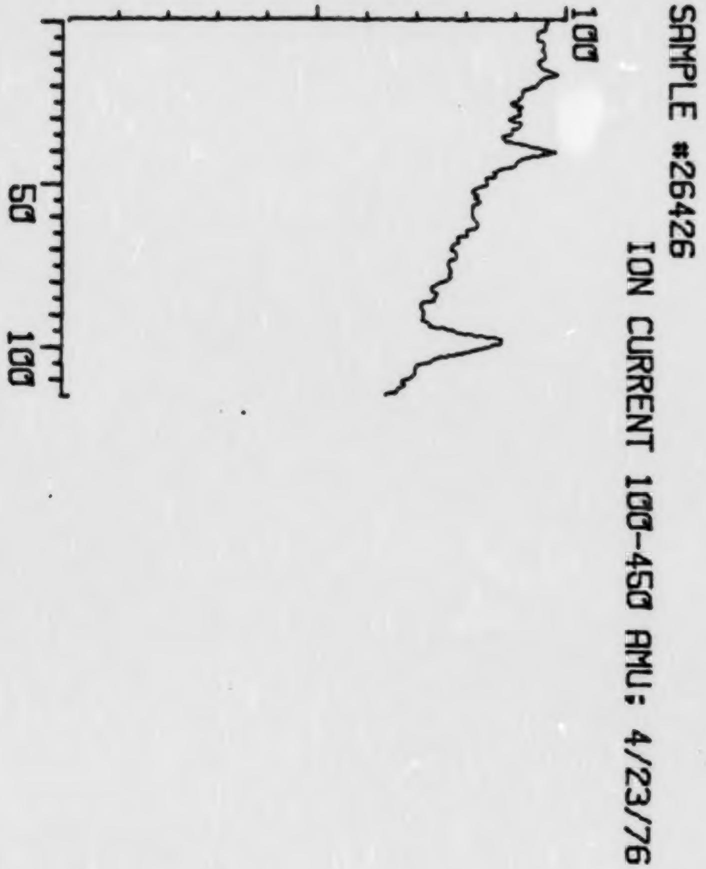
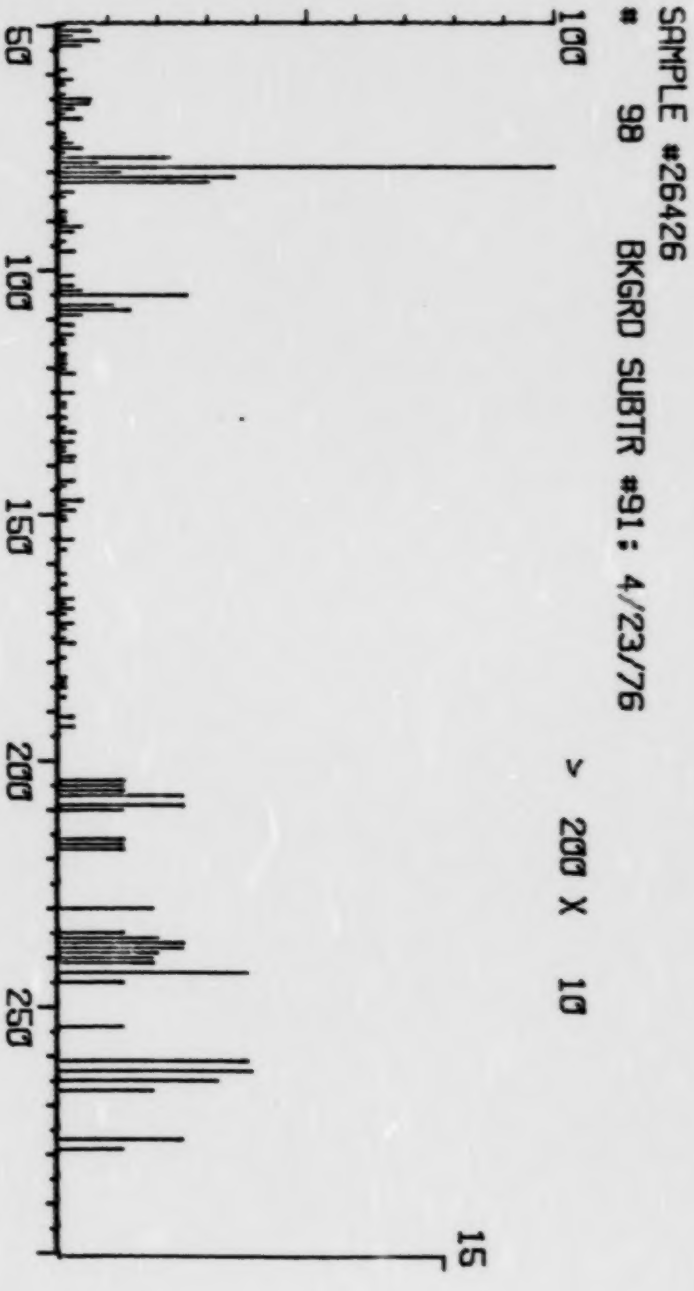


Figure 17 Ion Current Chromatogram-Sample No. 26426



Dieldrin

Retention time: 7.2 min

Figure 18 Mass Spectrum of Dieldrin from Sample No. 26426

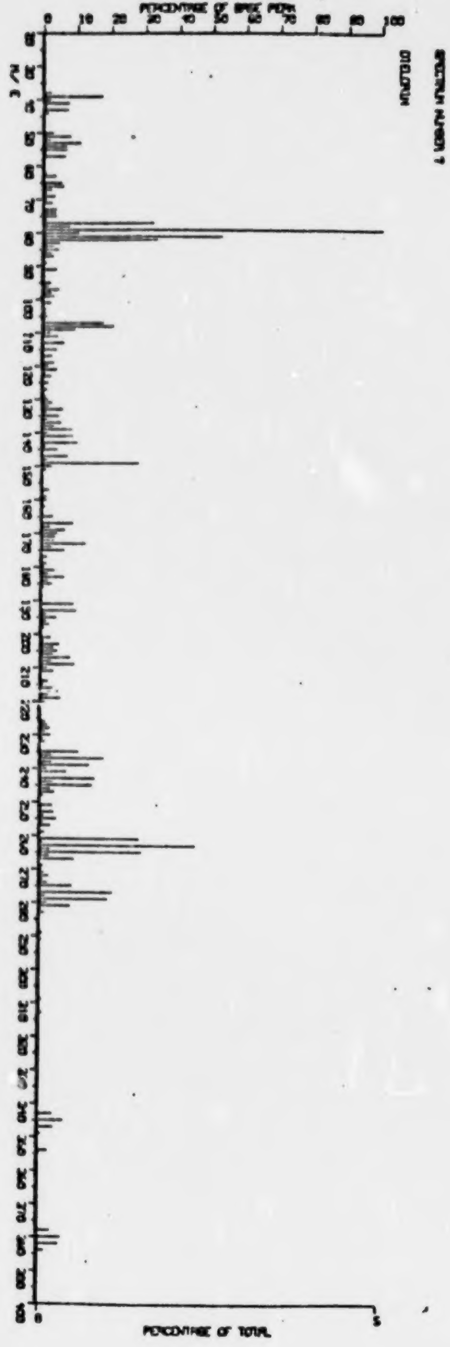


Figure 19 Mass Spectrum of Dieldrin

2. Sample 12523

The DDT level in this sample was 32 ppt; the total sample size was 800 ml of water. Since collection efficiency is about 60%, no attempt was made to collect a fraction from the preparative column. An amount equivalent to 600 ml water and 19 ng DDT injected into the gc/ms did not give a satisfactory spectrum because the amount of pesticide was too small. The total ion current chromatogram (shown in Figure 20) shows no evidence of a peak in the area of spectrum 174, the retention time of DDT.

C. Identification of Unknown Contaminants by GC/MS

Table I summarizes our findings; however, since each extract is unique, this section also discusses each extract individually. Those analyses performed on extracts of duplicate water samples are labeled "duplicate." Copies of standard mass spectra of the compounds identified are found immediately after the discussion of the individual samples, in Figures 49-60, pages 64 to 75 .

1. Sample 12522 (Duplicate)

The gc curve run before fraction collection shows a series of small peaks similar to chlorinated naphthalenes in both retention time and shape. This material was not present in sufficient amounts to obtain a complete mass spectrum of any one isomer; therefore, to obtain more definitive information, we ran a mass abundance specific for polychlorinated naphthalenes (PCNs) on several of the fractions collected at one time.[3,4] This collection is labeled #1 on the precollection gas chromatogram. Collection was started 2 min and 25 sec following injection and was ended 4 min and 15 sec following injection. The mass abundance spectra at m/e^+ 230 and 232, which were 100% and 98.4%, respectively, for trichloronaphthalene, revealed four possible isomers; the spectrum at m/e^+ 266, which was 100% for tetrachloronaphthalene, showed the presence of two possible isomers; the spectrum at m/e^+ 300, 100% for pentachloronaphthalene, showed no evidence of any isomers.

The fraction labeled #2 on the precollection gas chromatogram was collected between 4 min and 42 sec and 5 min and 25 sec following injection. From this fraction, we were able to obtain complete spectra of dibutyl phthalate and two tetrachloronaphthalene isomers. The spectra of these isomers compare well with known spectra and those given in the literature, particularly, in the very characteristic regions of the chlorine clusters. The chromatograms and mass spectral patterns for Sample 12522 are given in Figures 21-26.

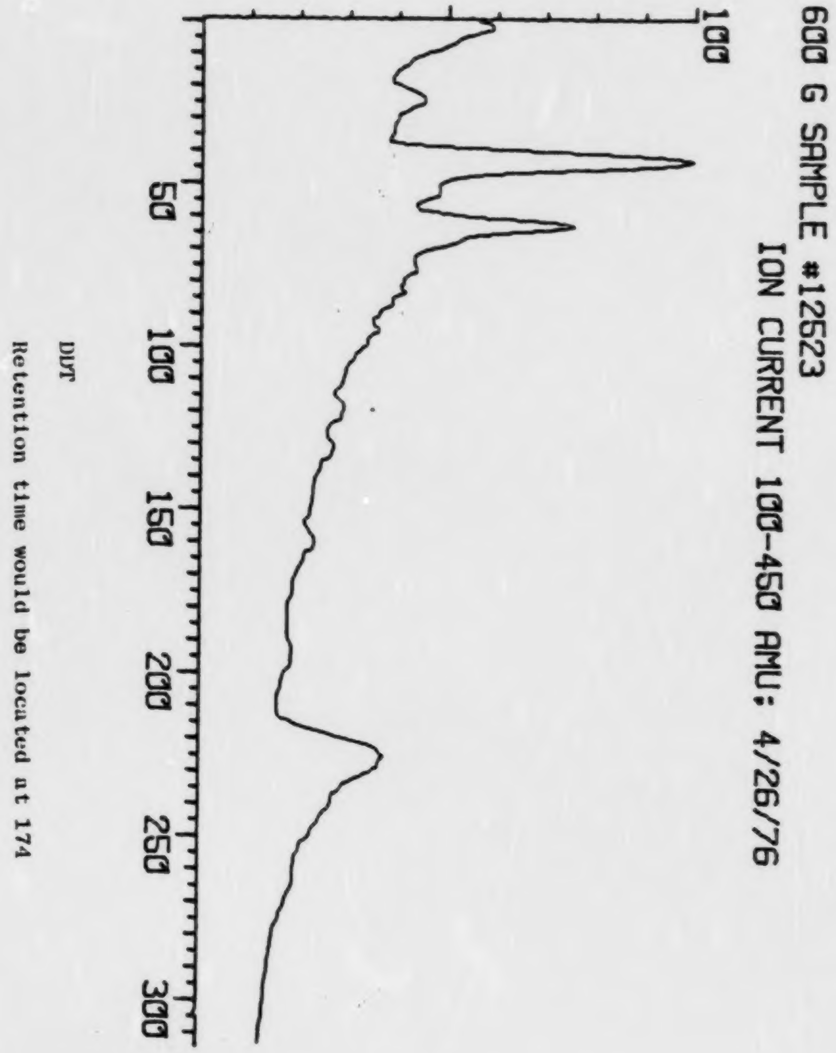


Figure 20 Ion Current Chromatogram-Sample No. 12523

Table I

CONTAMINANTS IDENTIFIED IN SPECIFIC SELECTED WATER EXTRACTS

Sample	Compounds Found	Quantitation* Minimum (ppb)	Quantitation* Maximum (ppb)
12522	2 tetrachloronaphthalene isomers	0.5	5.0
	Dibutyl phthalate	0.06	0.6
22504	Atrazine	0.6	6.0
	Diethyl phthalate	0.1	1.0
22519	Atrazine	0.6	6.0
	Dibutyl phthalate	0.1	1.0
	Anthracene or phenanthrene†	0.1	1.0
22520	Atrazine	0.4	4.0
23060	Dibutyl phthalate	0.1	1.0
26407	Atrazine	0.7	7.0
	Trichloronaphthalene	0.5	2.0
	Tetrachloronaphthalene	0.5	2.0
	Pentachloronaphthalene	0.5	2.0
	Dibutyl phthalate	0.3	60.0
	Dioctyl phthalate	0.3	60.0
	Butyl phthalyl butyl glycolate	0.1	1.0
	Triphenyl phosphate	0.1	1.0
26412	Atrazine	0.5	5.0
	Dibutyl phthalate	0.1	1.0

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[*] See discussion in text, page 30

[†] Undistinguishable by mass spectrum or retention time

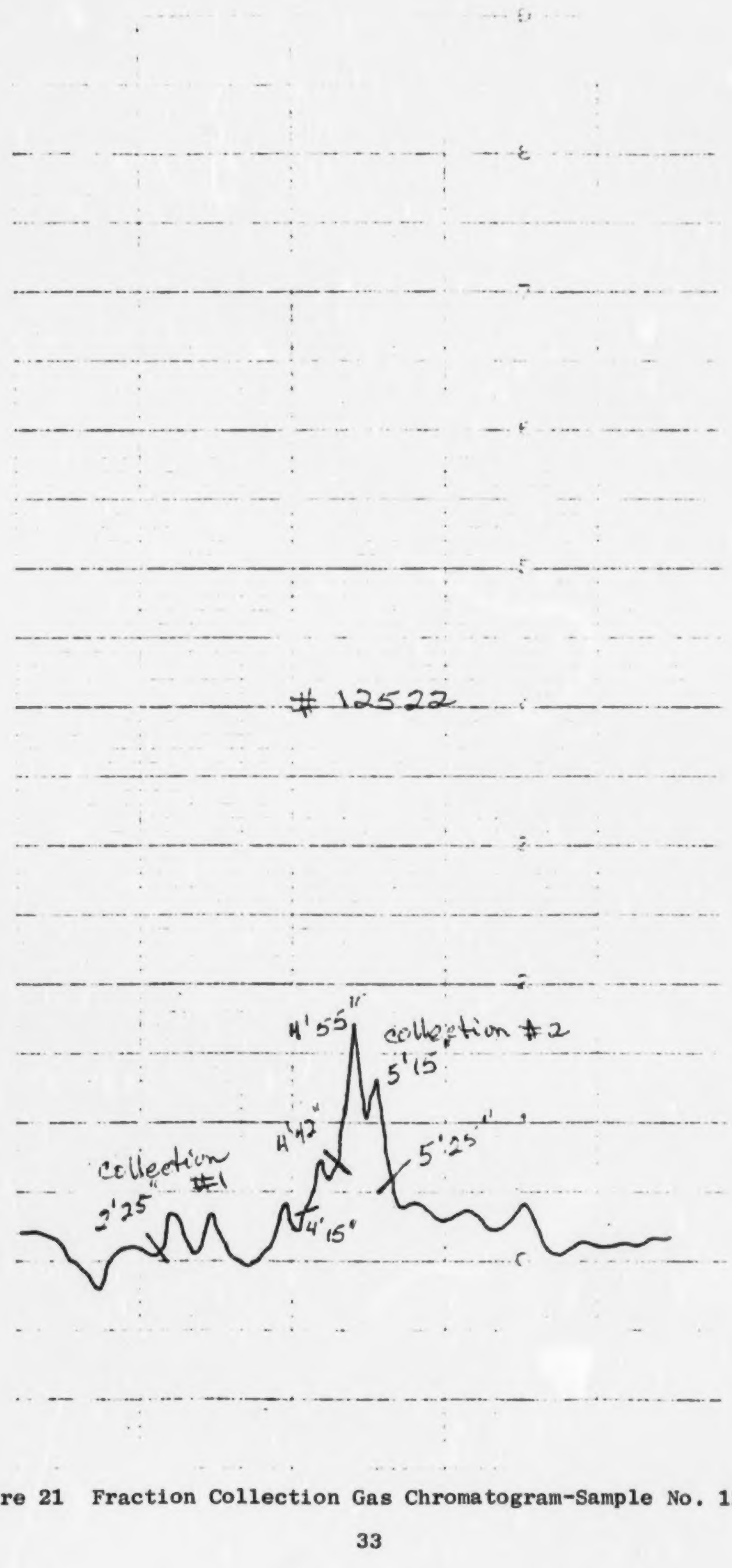


Figure 21 Fraction Collection Gas Chromatogram-Sample No. 12522

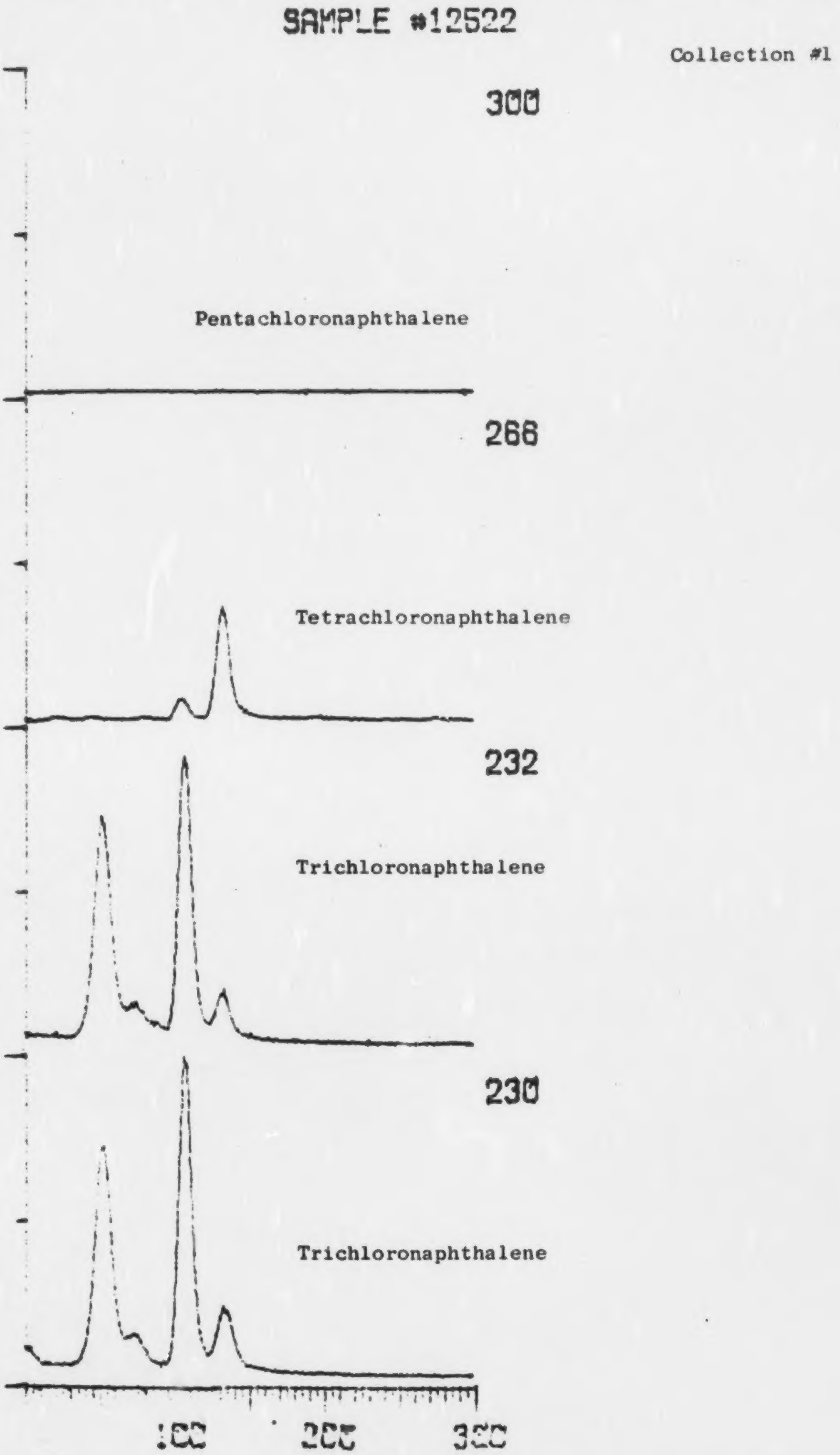


Figure 22 Mass Abundance Spectra of PCNs-Sample No. 12522

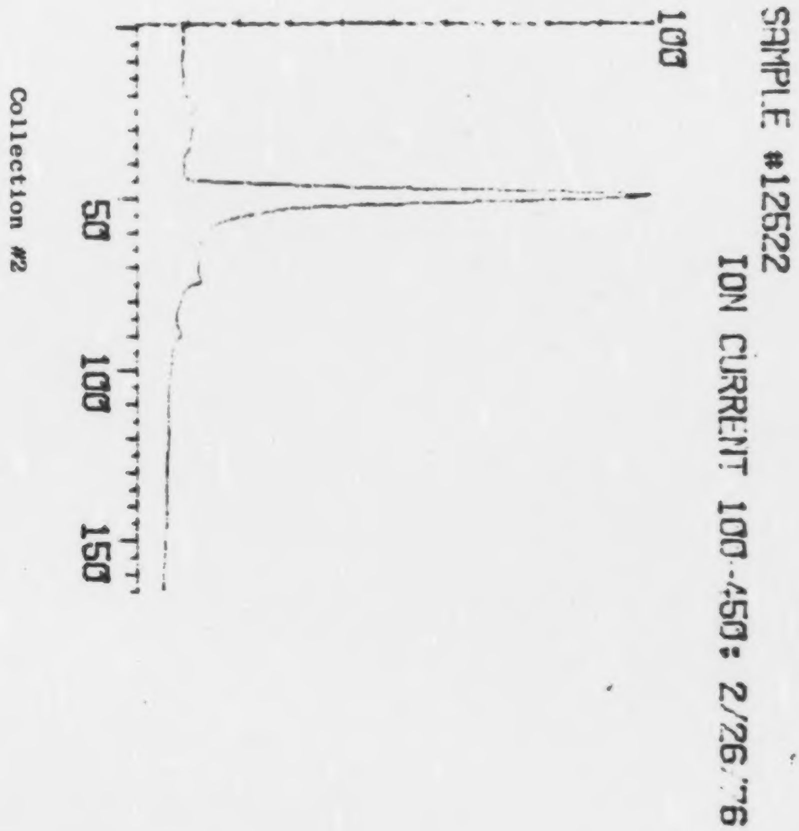
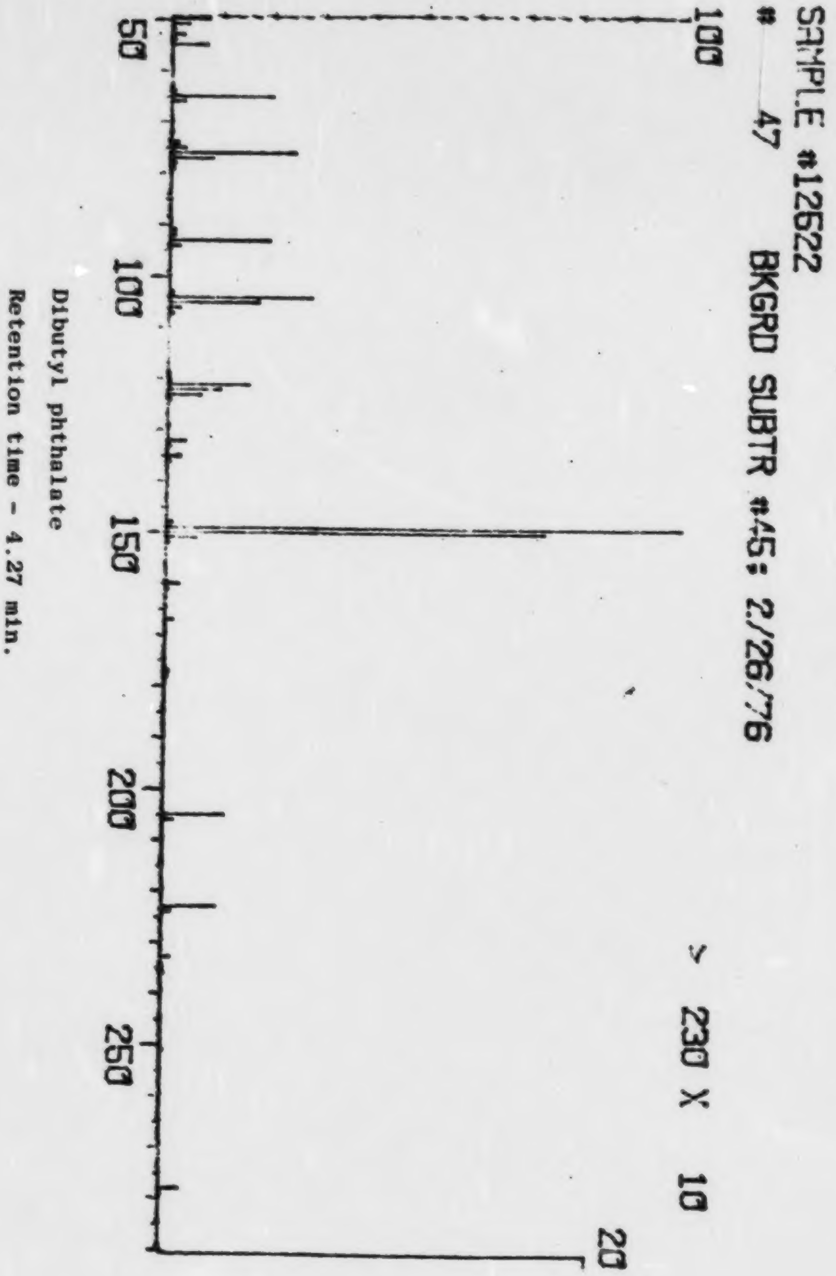


Figure 23 Ion Current Chromatogram, Fraction No. 2, Sample No. 12522



Dibutyl phthalate
Retention time - 4.27 min.

Figure 24 Dibutyl Phthalate Spectrum from Sample No. 12522

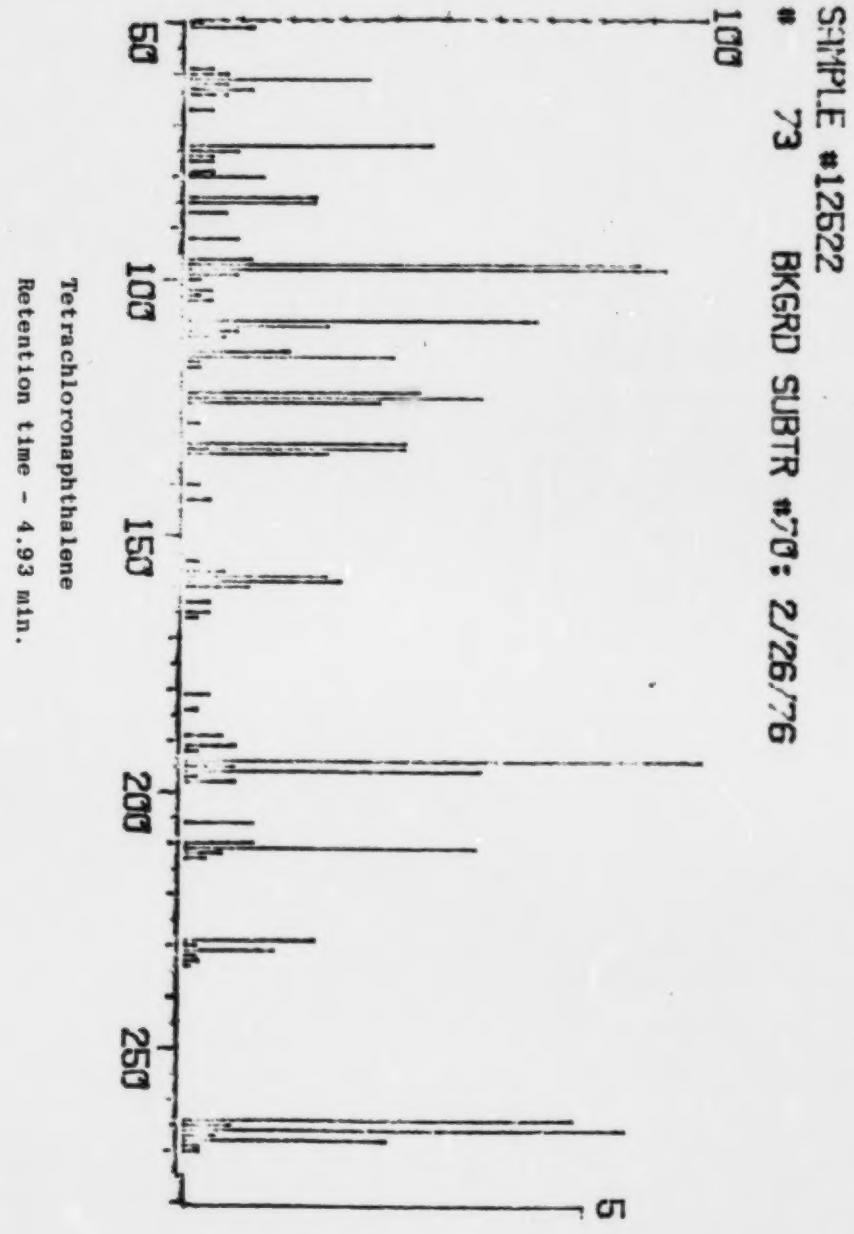
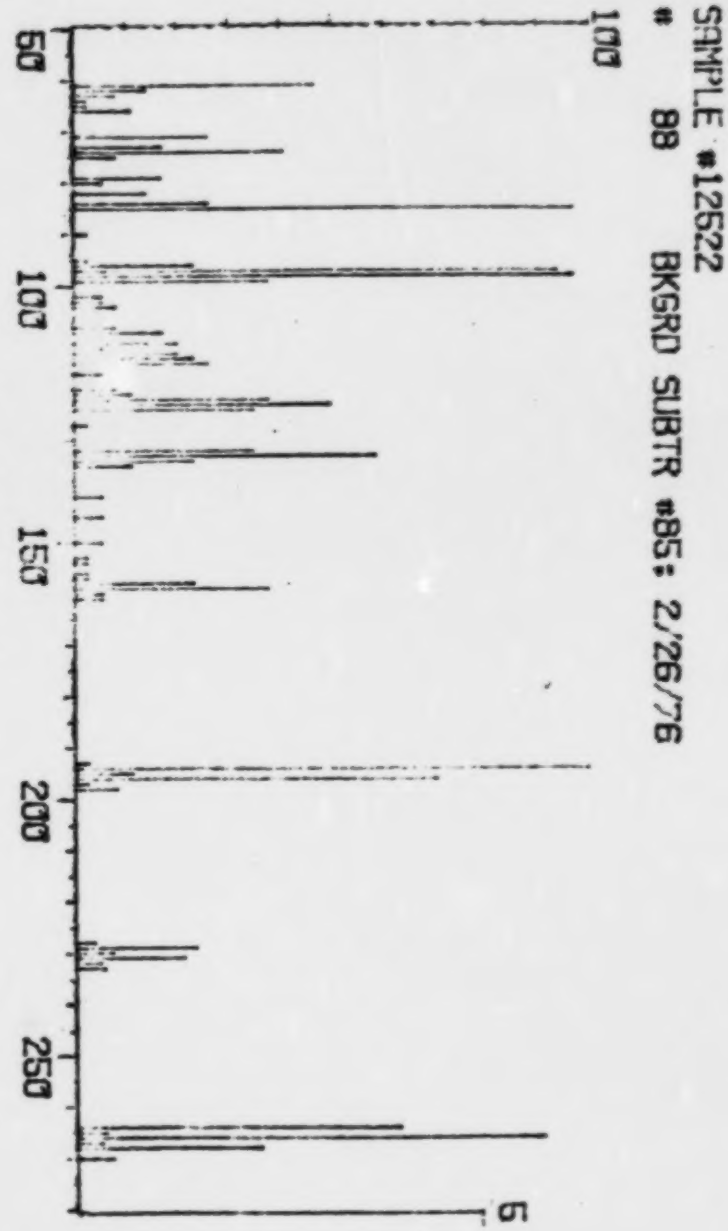


Figure 25 Tetrachloronaphthalene Isomer from Sample No. 12522



Tetrachloronaphthalene
Retention time - 5.43 min.

Figure 26 Tetrachloronaphthalene Isomer from Sample No. 12522

2. Sample 22504

This was the first sample extract on which fractions were collected from a gas chromatographic column and then analyzed by gc/ms. Inadvertently, we discarded the precollection gas chromatogram. A copy of the original gas chromatographic screening curve is included with the data sheets and is marked to show when the fraction was collected. During the screening process for aldrin, dieldrin, DDT, and DDT metabolites, the injection was vented for three minutes. When the vent was closed, the curve indicates the tail of a large peak and another large peak very close to it. The collected fraction included both of these peaks. Collection was begun 2 min. following injection and completed at 4 min. following injection. Atrazine and diethyl phthalate were found in this sample. In the mass spectrum of the diethyl phthalate curve labeled #18 BKGRD SUBTR # 16, all m/e^+ above 200 are multiplied by 10. In this way, the parent peak at m/e^+ 222 may be seen more easily. Curves and spectra for this sample are given in Figures 27-29.

3. Sample 22519

The fraction of this sample for mass spectral analysis was collected between 1 min and 55 sec and 2 min and 22 sec following injection. The ion current chromatogram revealed two large chromatographic peaks and several small ones. Three of these peaks were caused by atrazine, dibutyl phthalate, and anthracene or phenanthrene. The dibutyl phthalate spectrum labeled #56 BKGRD SUBTR #52 is normalized to the m/e^+ of 150 fragment, rather than to the base peak at the m/e^+ of 149 fragment.

The spectrum labeled #35 BKGRD SUBTR #33 has been identified as anthracene or phenanthrene. When the mass spectral data were fed into the Mass Spectral Search System, possible identifications were anthracene, phenanthrene, or diphenyl acetylene. These compounds all have the empirical formula $C_{14}H_{10}$; by comparing our unknown spectrum with the spectrum of diphenyl acetylene in the Registry of Mass Spectral Data, we can rule out this compound on the basis of the comparison of the peak intensities at m/e^+ 76 and 88 with the intensities at m/e^+ 174 and 179. A comparison of the standard spectra of anthracene and phenanthrene given in the Registry of Mass Spectral Data with the spectra derived from our own standards, reveals that these spectra are virtually indistinguishable. Retention times on OV-17 are also too close to be used as a basis for distinguishing one from the other. An extra peak in this spectrum at m/e^+ 149 was probably caused by phthalate interference. Curves and spectra for this sample are given in Figures 30-32.

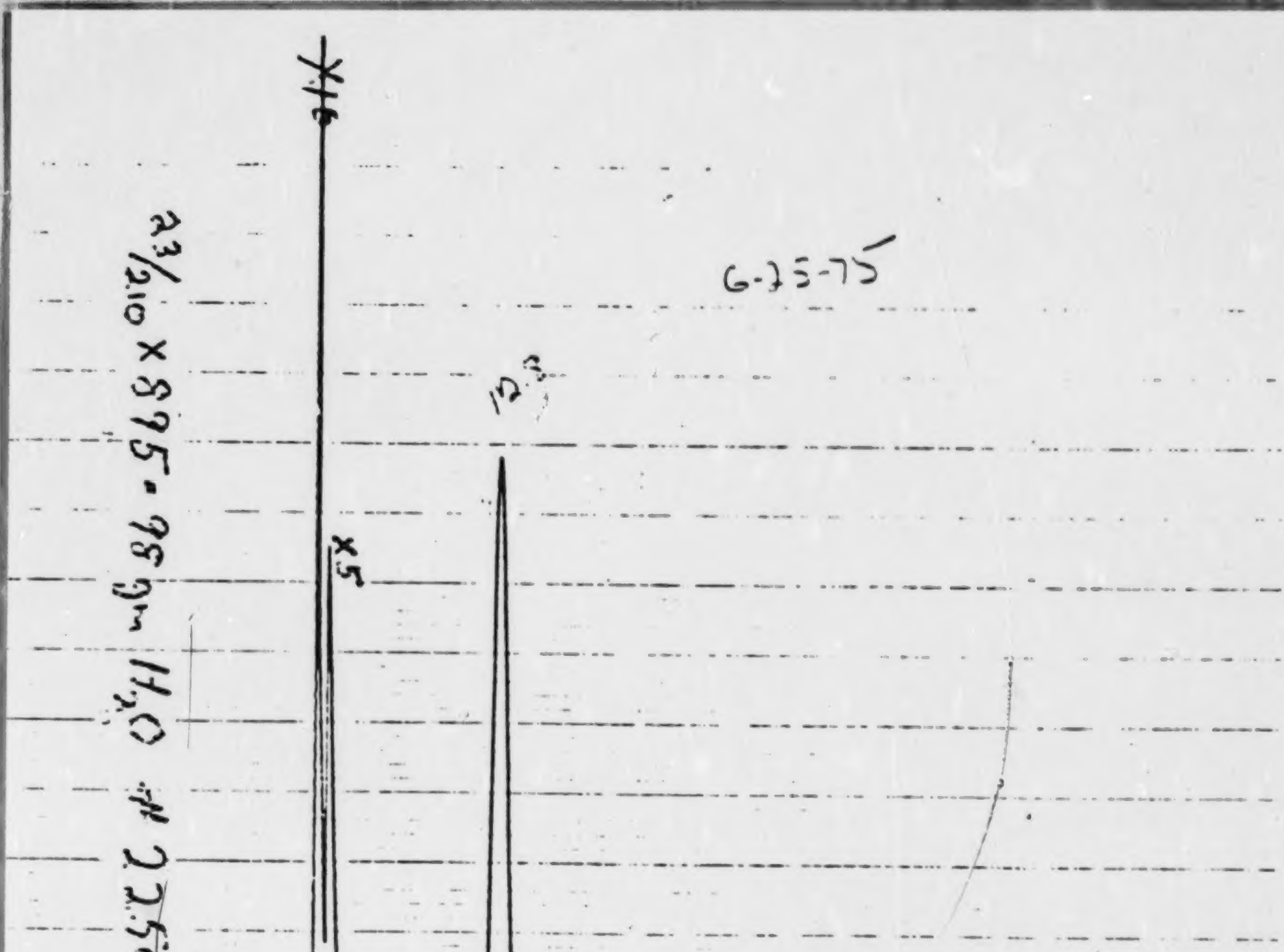


Figure 27 Original Gas Chromatographic Curve-Sample No. 22504

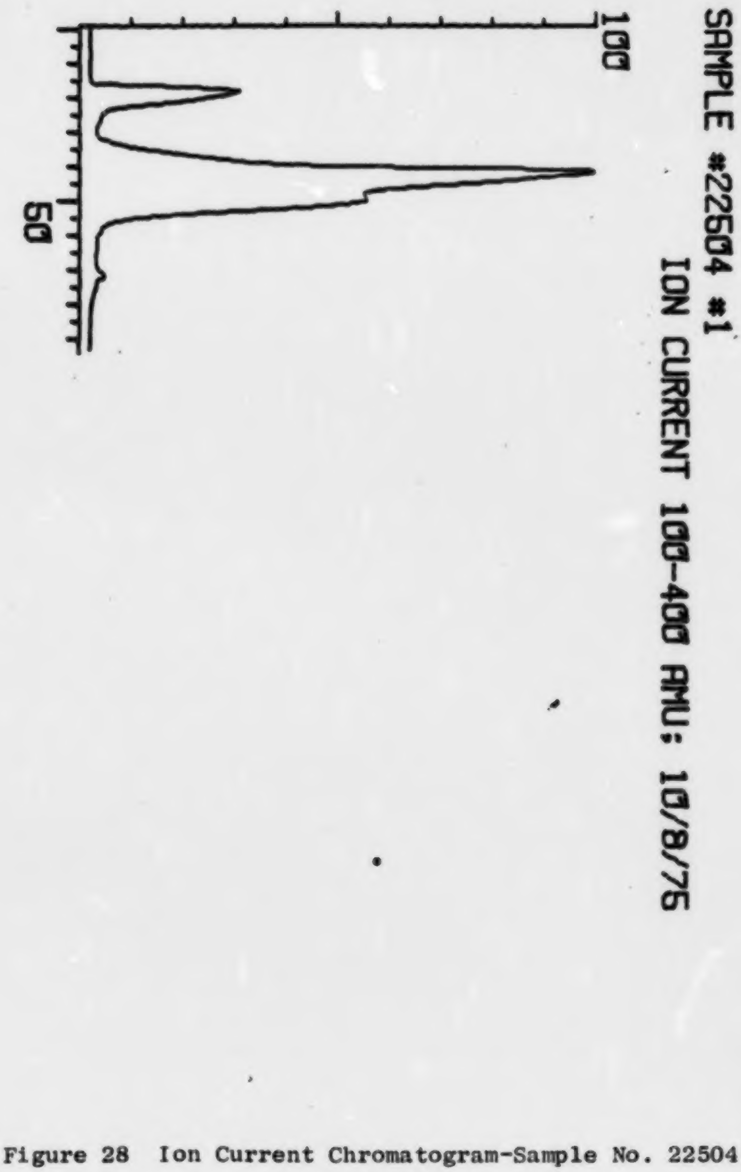


Figure 28 Ion Current Chromatogram-Sample No. 22504

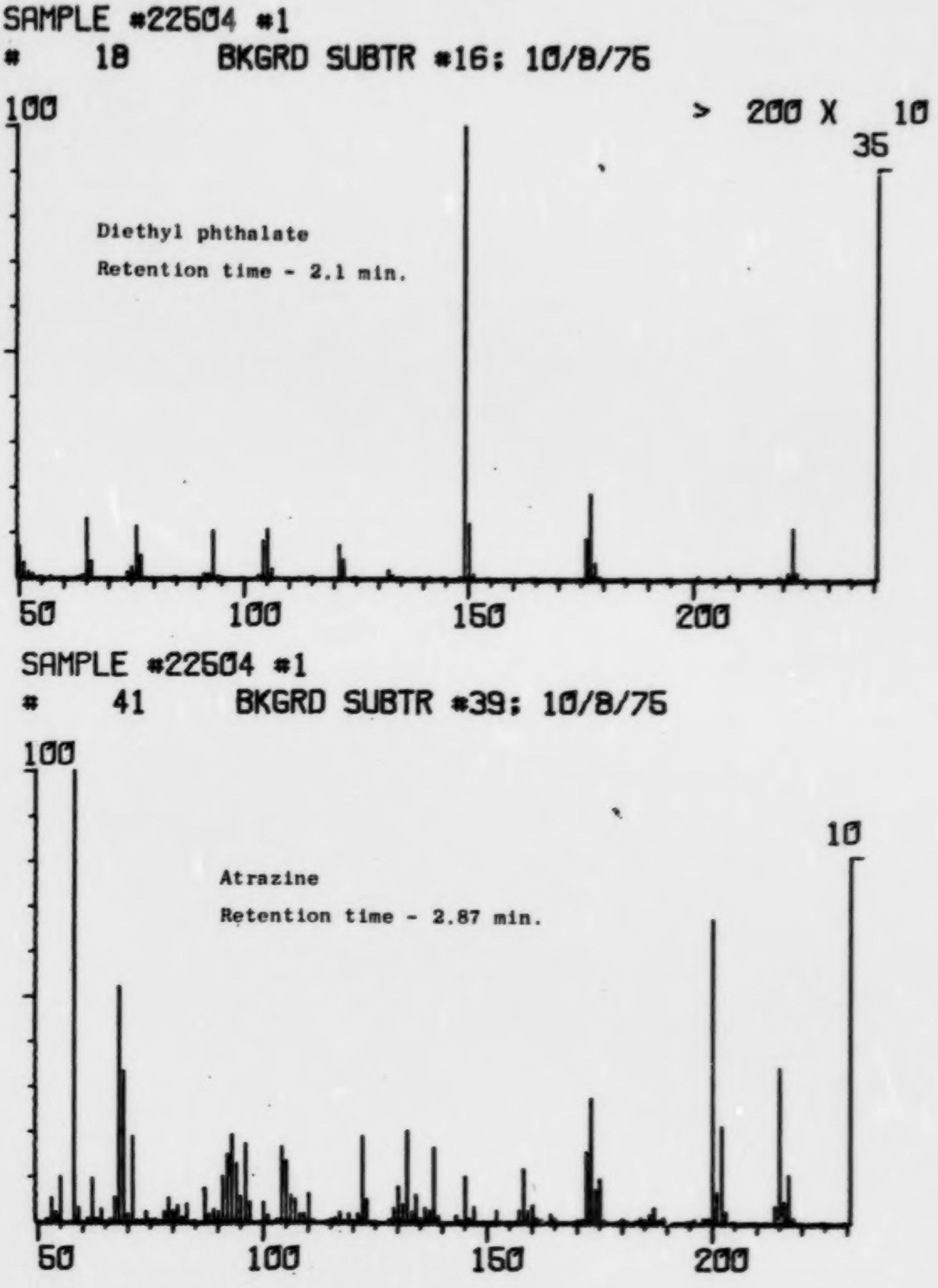


Figure 29 Mass Spectra of Diethyl Phthalate and Atrazine-Sample No. 22504

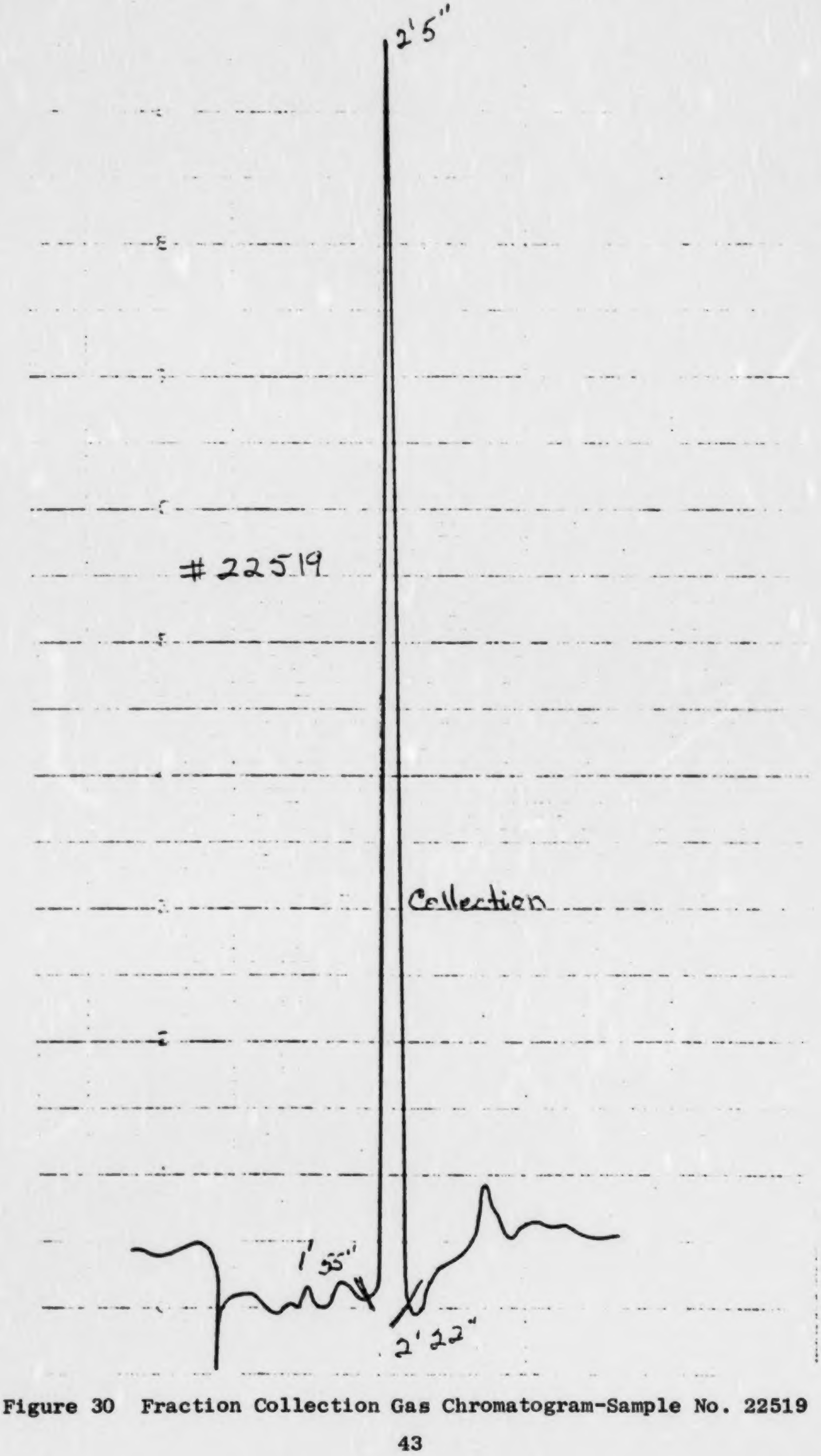
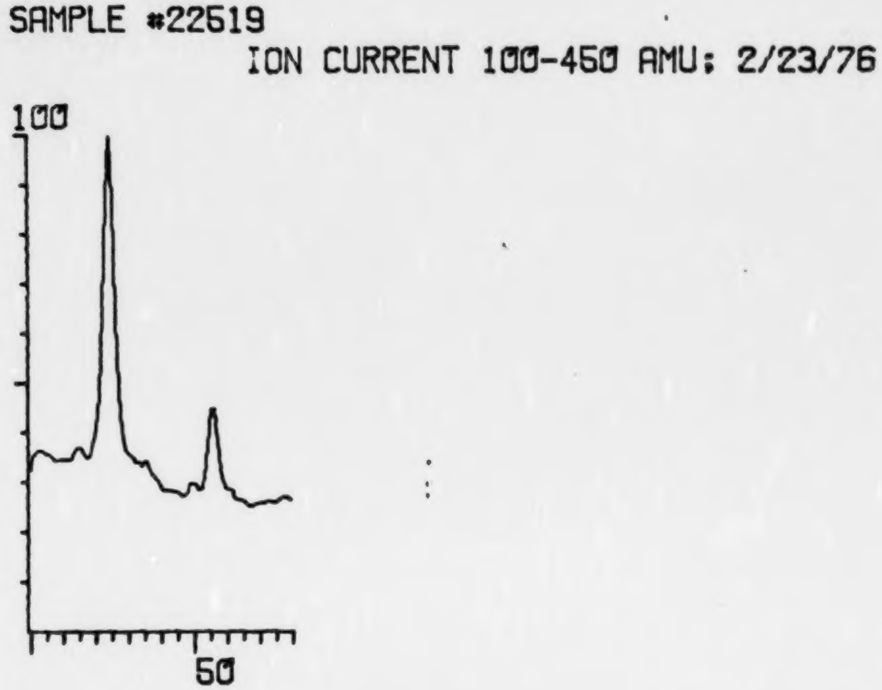
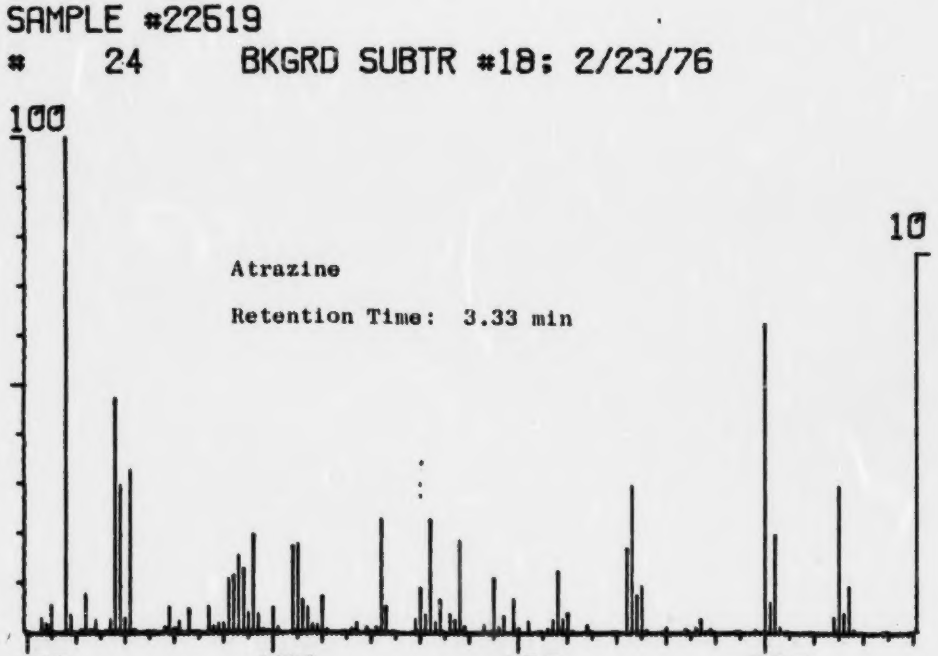


Figure 30 Fraction Collection Gas Chromatogram-Sample No. 22519





Atrazine

Retention Time: 3.33 min

Figure 31 Ion Current Chromatogram and Mass Spectrum of Atrazine-Sample No. 22519

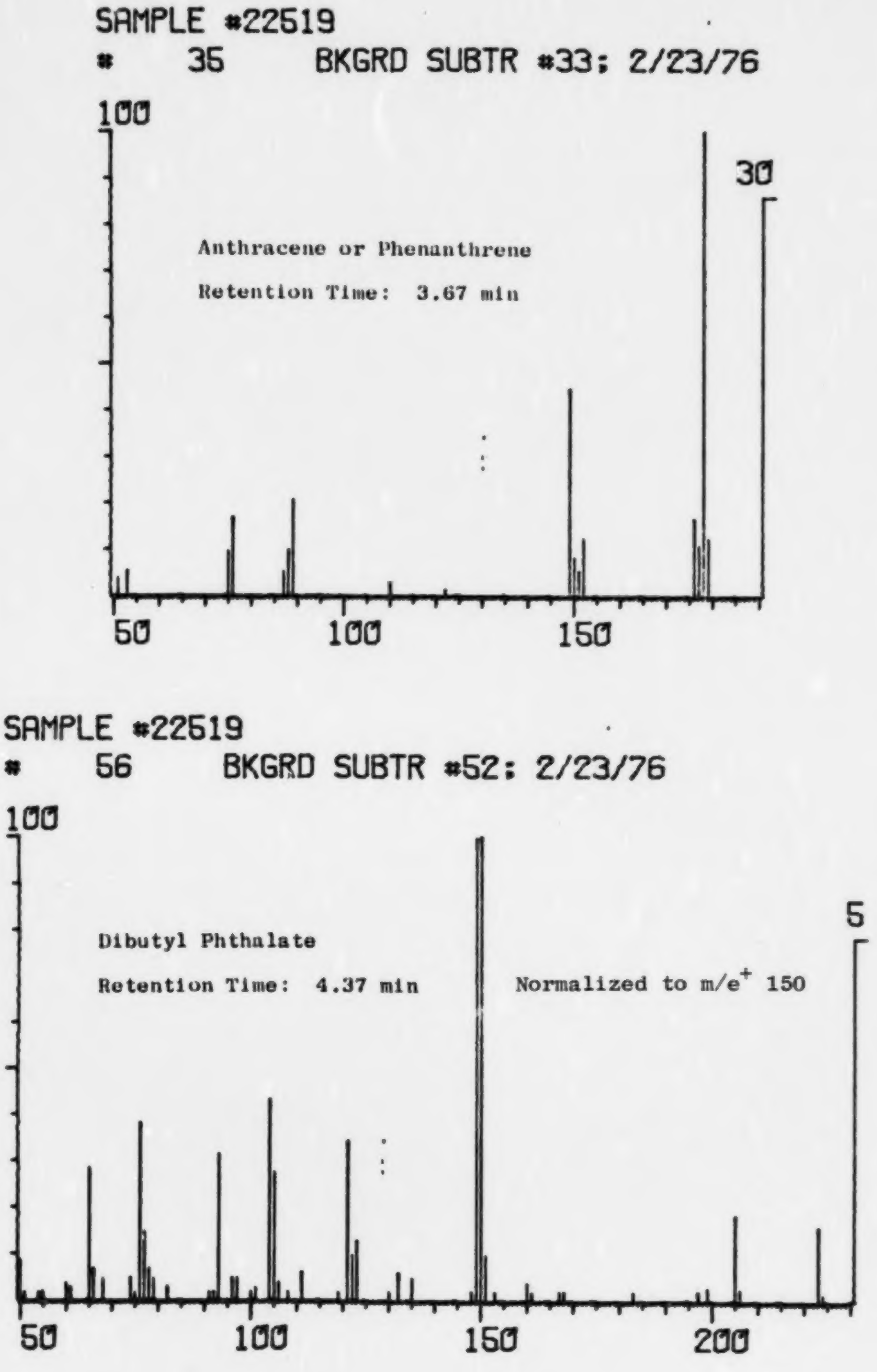


Figure 32 Mass Spectra of Anthracene/Phenanthrene and Dibutyl Phthalate-Sample No. 22519

4. Sample 22520

This fraction was collected between 2 min and 26 sec and 2 min and 45 sec following injection. Atrazine was the only compound identified from the mass spectral data obtained from this sample. The curve and spectrum are given in Figures 33 and 34.

5. Sample 23060

A fraction from this sample was collected from 4 min and 42 sec to 5 min and 10 sec after injection. The only compound identified in this sample was dibutyl phthalate. The curve and spectrum are given in Figures 35 and 36.

6. Sample 26407

During the mass fragmentation analysis of this sample for heptachlor, heptachlor epoxide, and/or γ chlordane, we observed several peaks at m/e^+ 230 (the base peak for the o-terphenyl internal standard, added to the sample for quantitation purposes) rather than one peak as expected. This is also the 100% peak for trichloronaphthalene, as discussed under Sample 12522. Therefore, although we originally did not intend to study this sample extract, we decided to pursue this finding further.

An aliquot of the whole sample was injected into the gc/ms, which had been set to monitor the mass abundances at m/e^+ 300 for pentachloronaphthalene, m/e^+ 266 for tetrachloronaphthalene, and m/e^+ 230 and 232 for trichloronaphthalene. The resulting curves revealed the possible presence of one or two trichloronaphthalenes, about four tetrachloronaphthalenes, and two or three pentachloronaphthalenes. Because only 180 gm equivalent of water remained, all the extract was injected into the gc/ms, which was set to cover a mass range of 50-450 amu. The chromatogram was allowed to run for about 11 minutes to allow all the material of interest to elute from the gc column. The stored data for this ion current chromatogram were monitored (on the oscilloscope screen) at the appropriate m/e^+ values to help locate the tri-, tetra-, and pentachloronaphthalene isomers indicated in the preliminary mass abundance curves. The mass spectra thus obtained for these three isomers compared well with standard spectra, particularly in the characteristic areas of the chlorine isotope clusters.

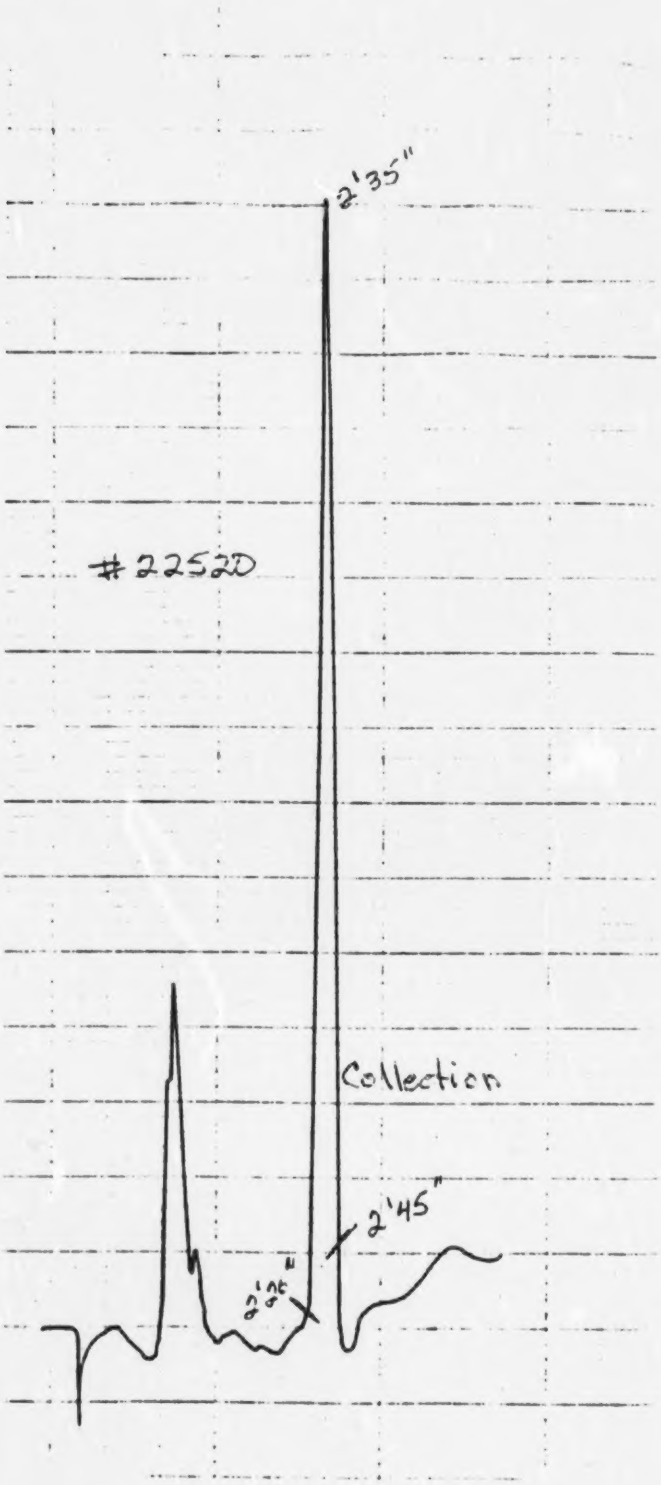
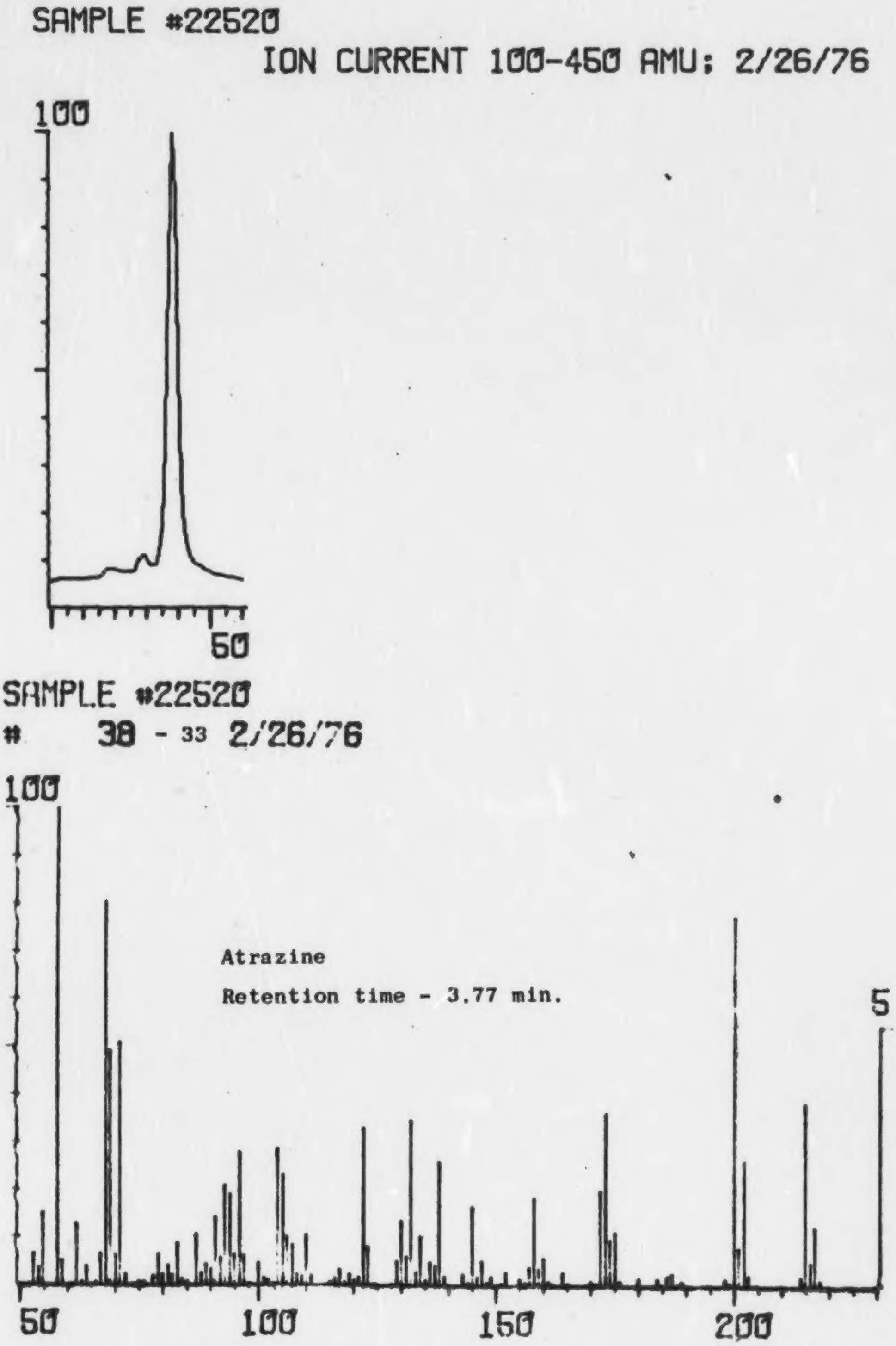


Figure 33 Fraction Collection Gas Chromatogram-Sample No. 22520



Atrazine

Retention time - 3.77 min.

Figure 34 Ion Current Chromatogram and Mass Spectrum of Atrazine-Sample No. 22520

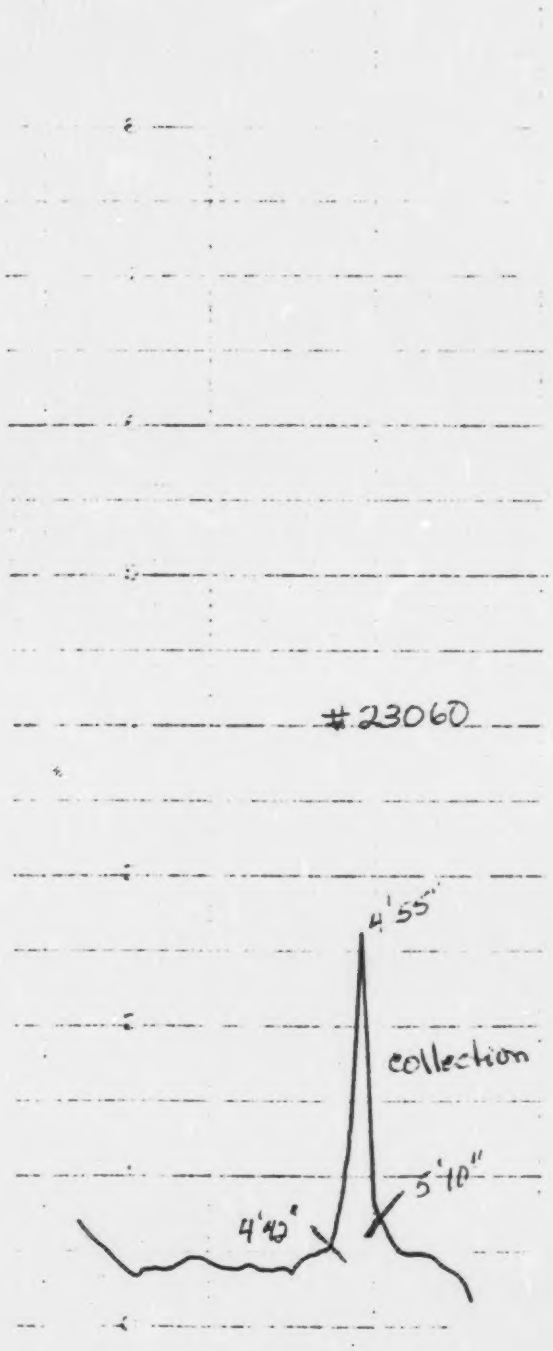


Figure 35 Fraction Collection Gas Chromatogram-Sample No. 23060

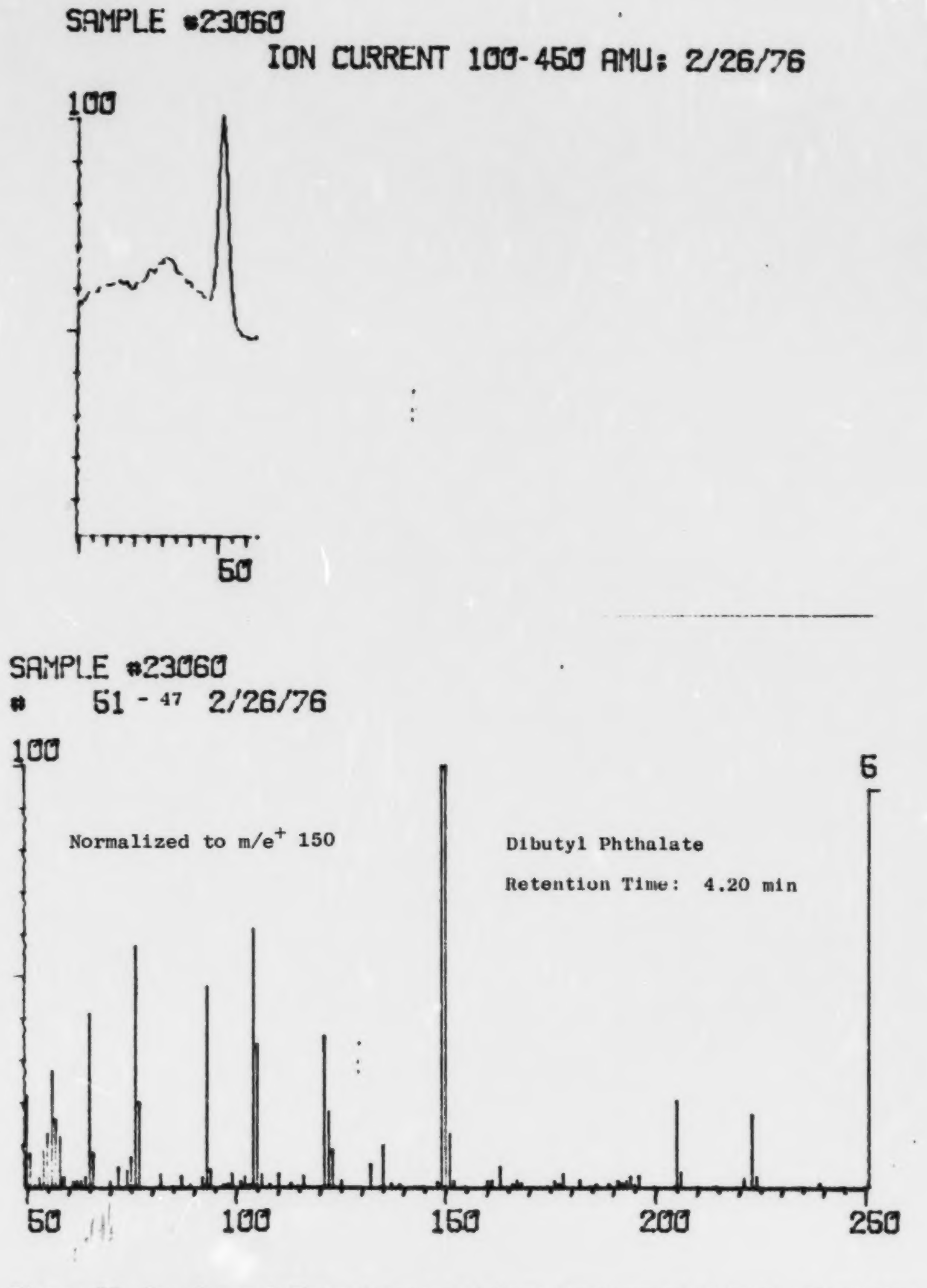


Figure 36 Ion Current Chromatogram and Mass Spectrum of Dibutyl Phthalate-Sample No. 23060

Atrazine, dibutyl and dioctyl phthalates, butyl phthalyl butyl glycolate, and triphenyl phosphate were then identified in the usual way by selecting a promising peak, subtracting an appropriate background, obtaining a plot of the resulting spectrum, and feeding these data into our own mass spectral library and the Mass Spectral Search System to obtain a list of possible compounds. Known spectra of these compounds were then compared with our unknown spectrum to confirm or refute the identification. Curves and spectra are given in Figures 37-44.

7. Sample 26412

Two collections of this sample were made from the micropreparative column. The first was collected between 2 min and 28 sec. and 2 min and 55 sec following injection and consisted of a single peak on our precollection gc. The second was collected between 3 min and 10 sec and 5 min after injection and showed two peaks on our precollection gc with retention times at 4 min and 10 sec and 5 min after injection. We have identified atrazine in the first fraction collection and dibutyl phthalate in the second. Curves and spectra are given in Figures 45-48.

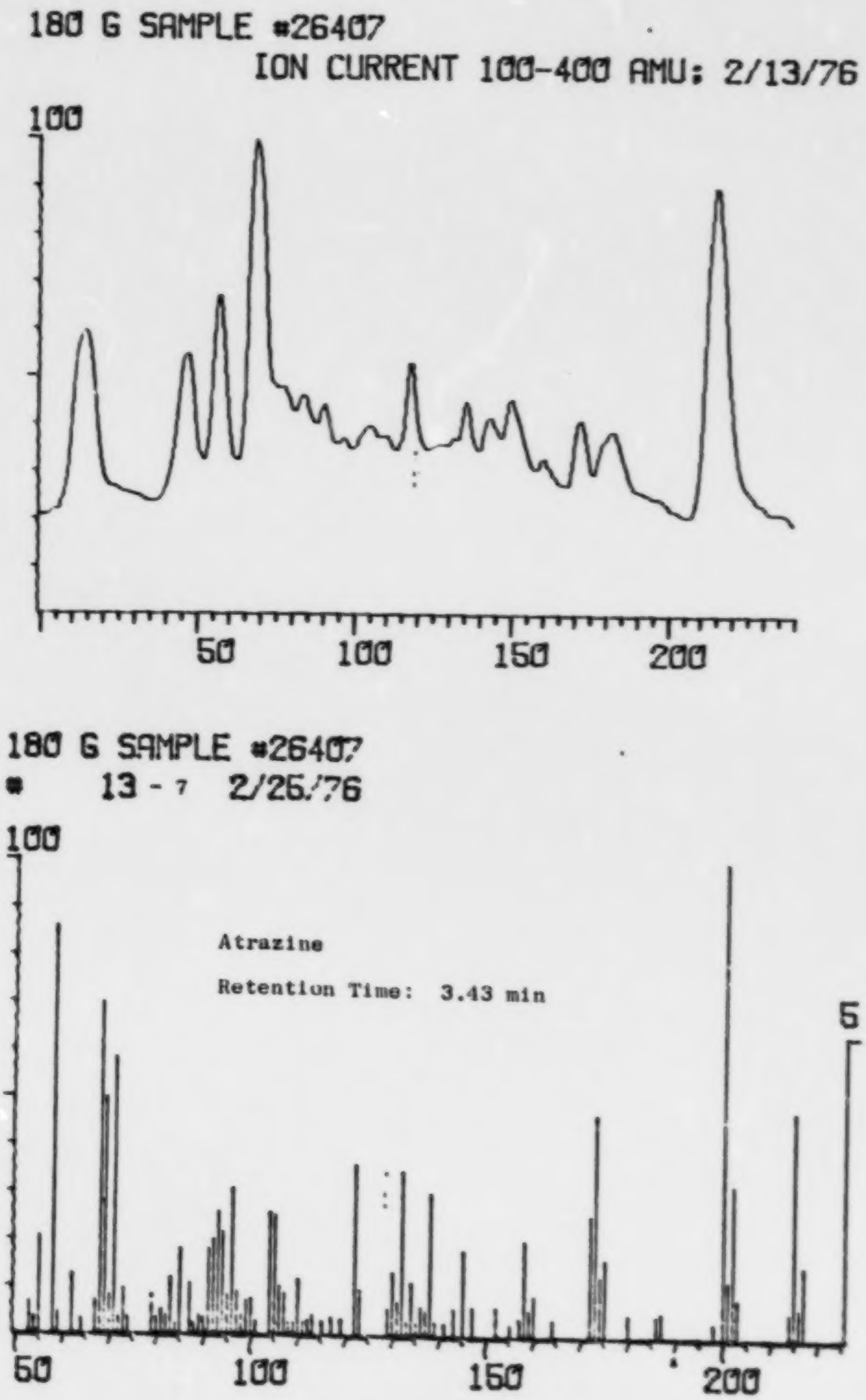


Figure 37 Ion Current Chromatogram and Mass Spectrum of Atrazine-Sample No. 26407

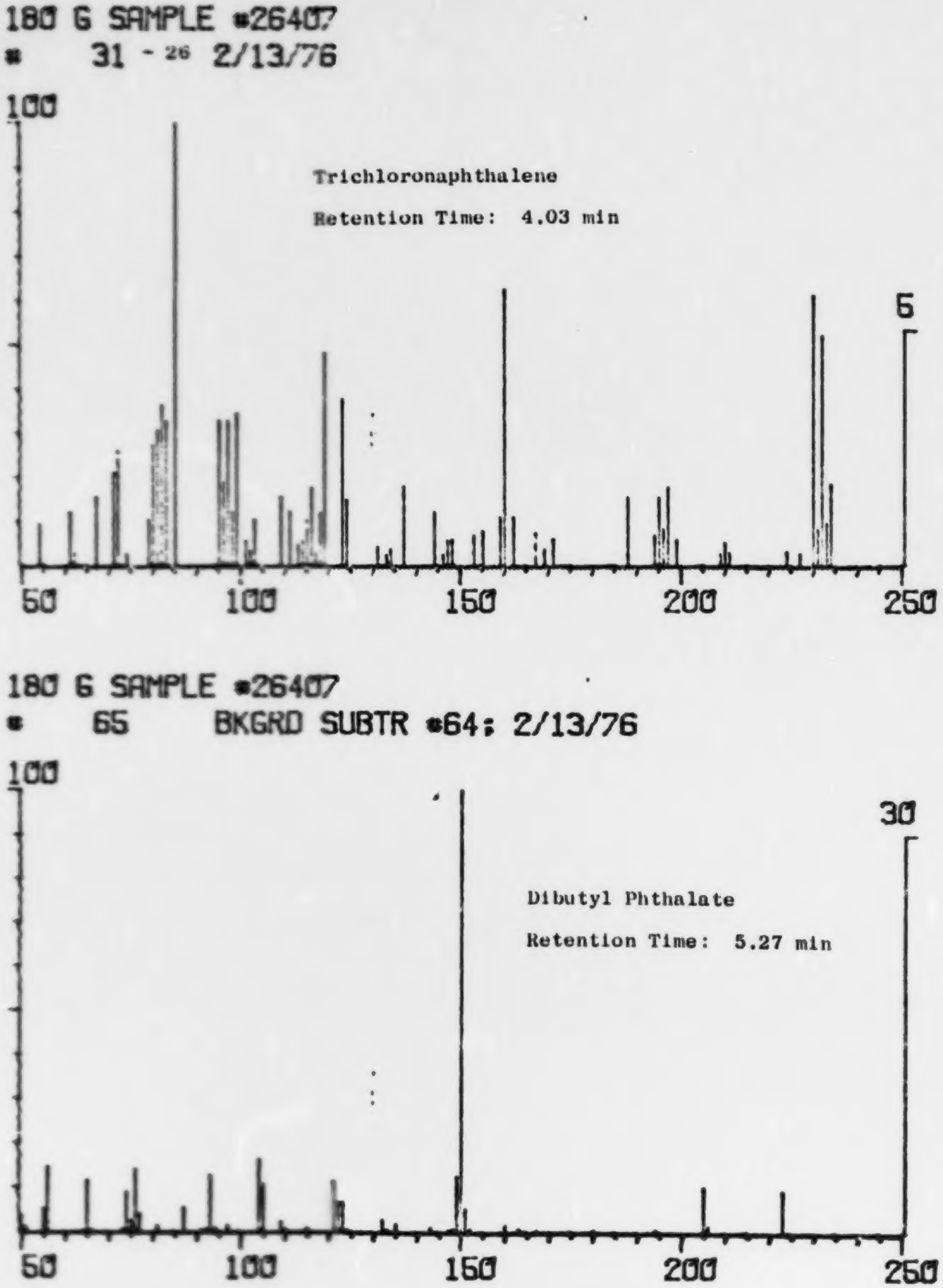
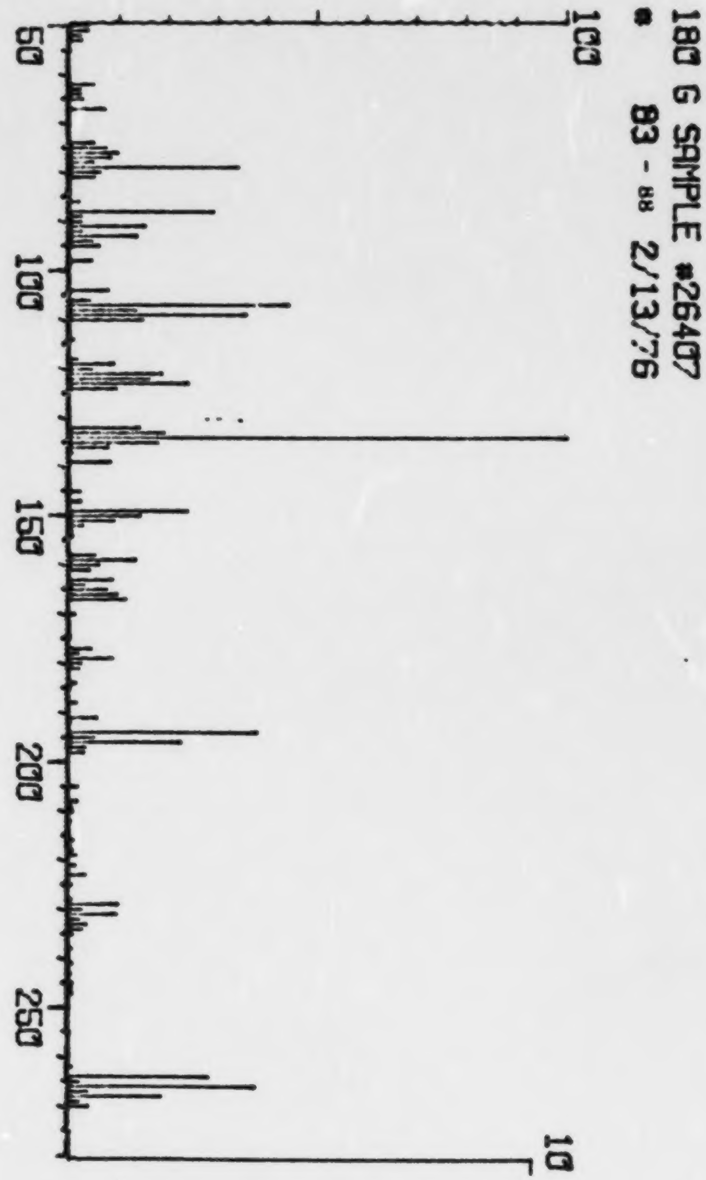


Figure 38 Mass Spectra of a Trichloronaphthalene and Dibutyl Phthalate-
Sample No. 26407



Tetrachloronaphthalene

Retention Time: 5.77 min

Figure 39 Mass Spectrum of a Tetrachloronaphthalene-Sample No. 26407

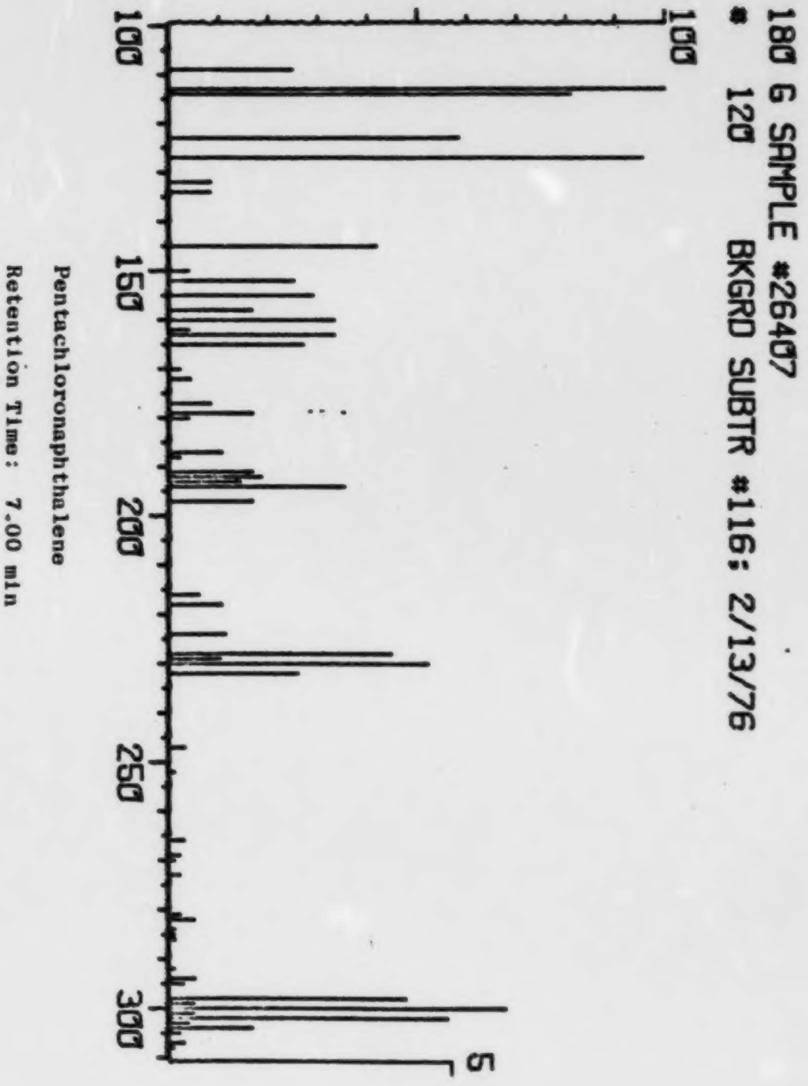
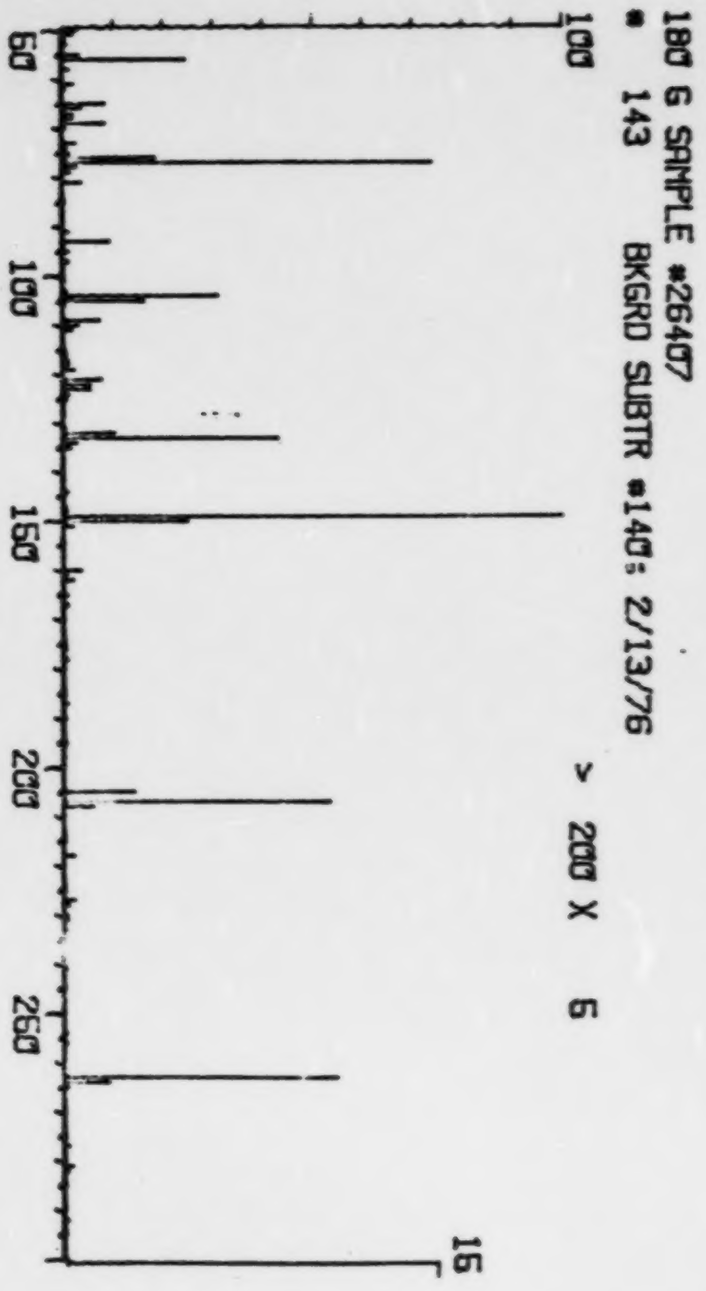


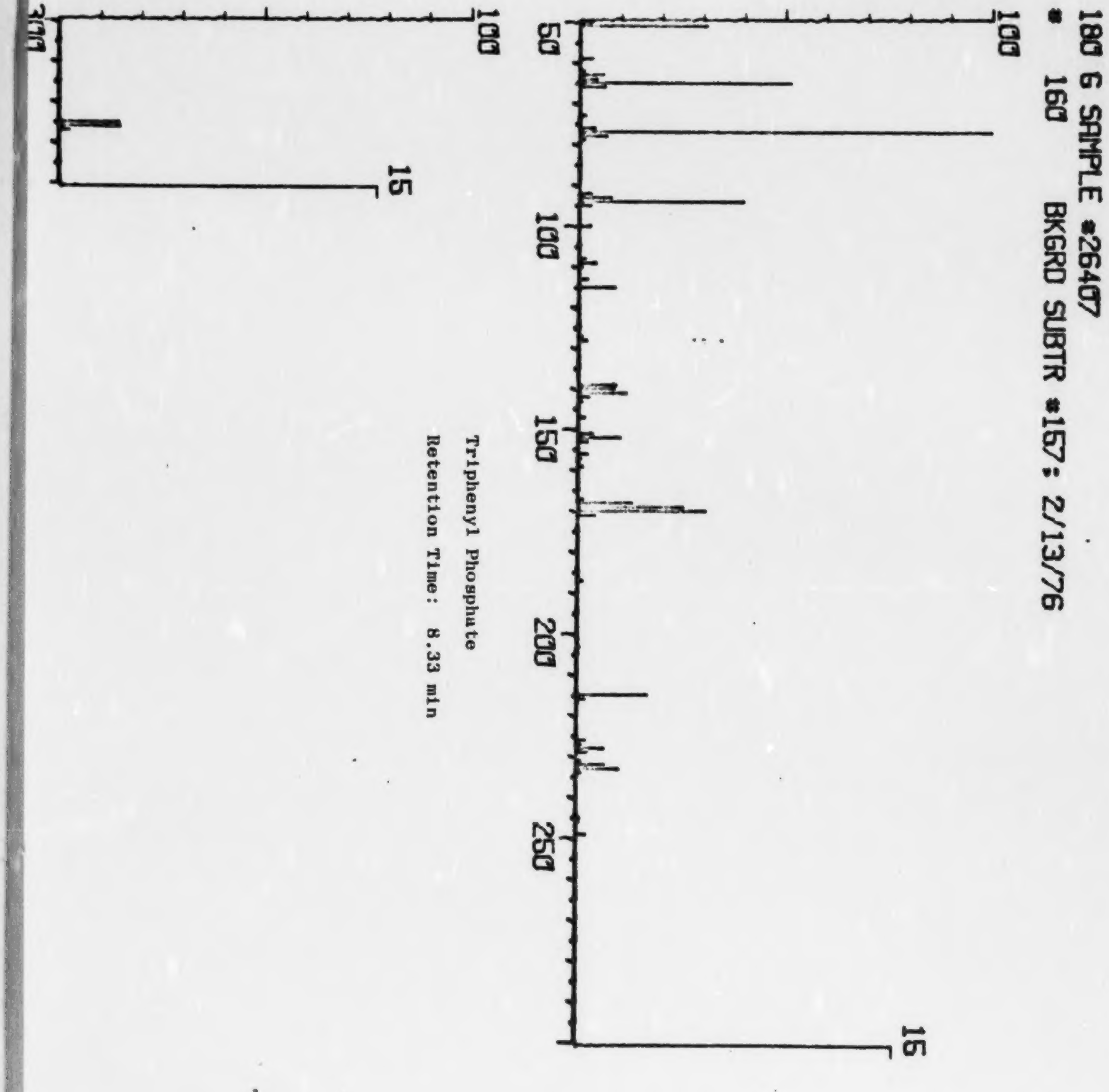
Figure 40 Mass Spectrum of a Pentachloronaphthalene-Sample No. 26407



Butyl Phthalyl Butyl Glycolate

Retention Time: 7.77 min

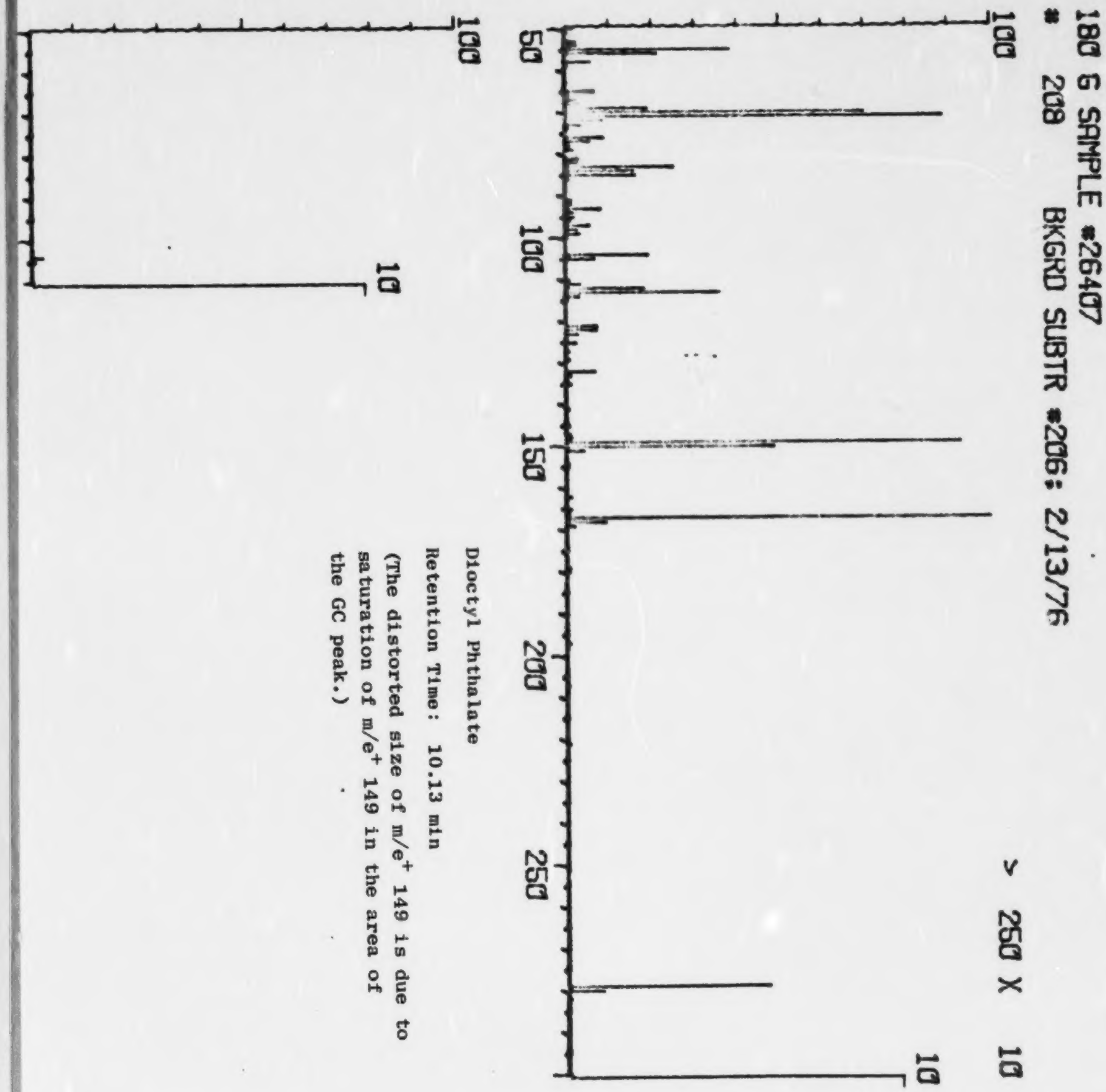
Figure 41 Mass Spectrum of Butyl Phthalyl Butyl Glycolate-Sample No. 26407



Triphenyl Phosphate

Retention Time: 8.33 min

Figure 42 Mass Spectrum of Triphenyl Phosphate-Sample No. 26407



Dioctyl Phthalate

Retention Time: 10.13 min

(The distorted size of m/e$^+$ 149 is due to saturation of m/e$^+$ 149 in the area of the GC peak.)

Figure 43 Mass Spectrum of Dioctyl Phthalate-Sample No. 26407

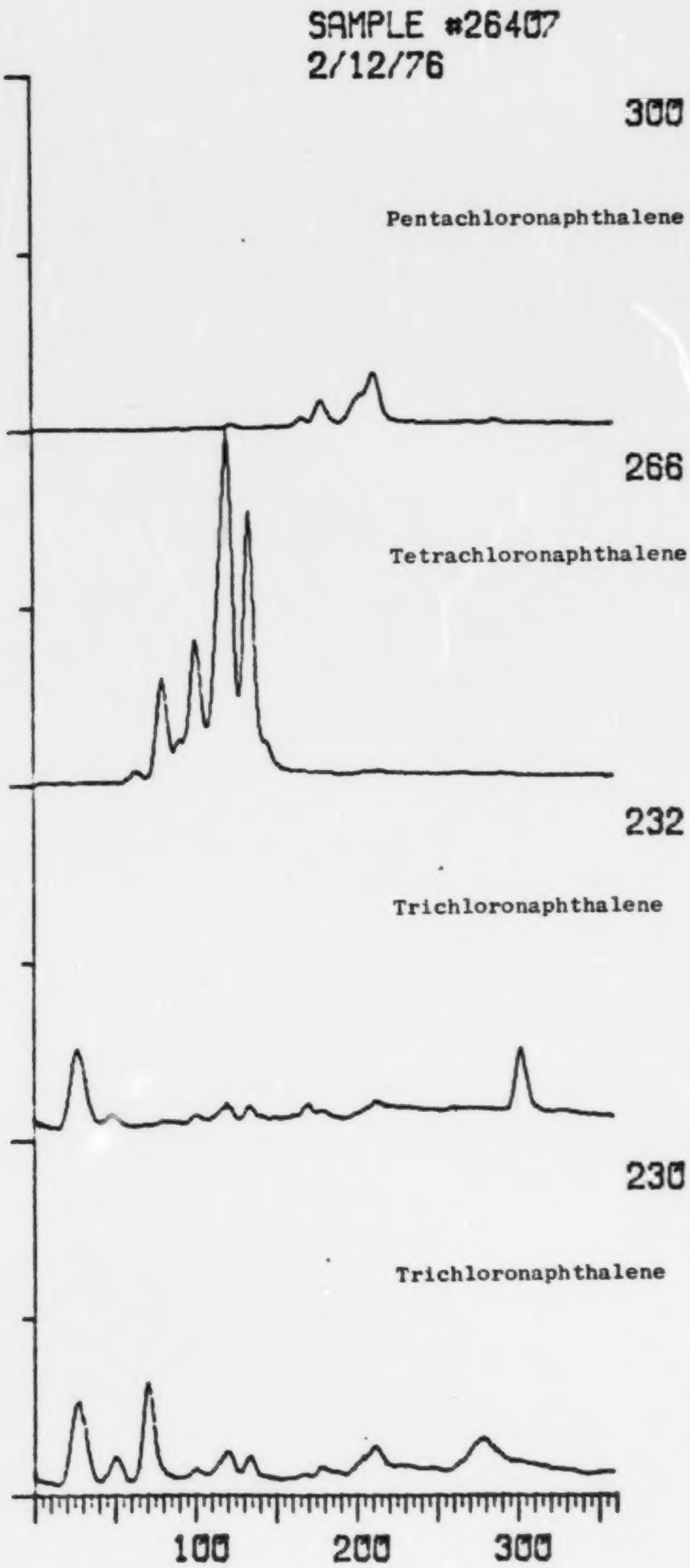


Figure 44 Mass Abundance Spectra of PCNs-Sample No. 26407

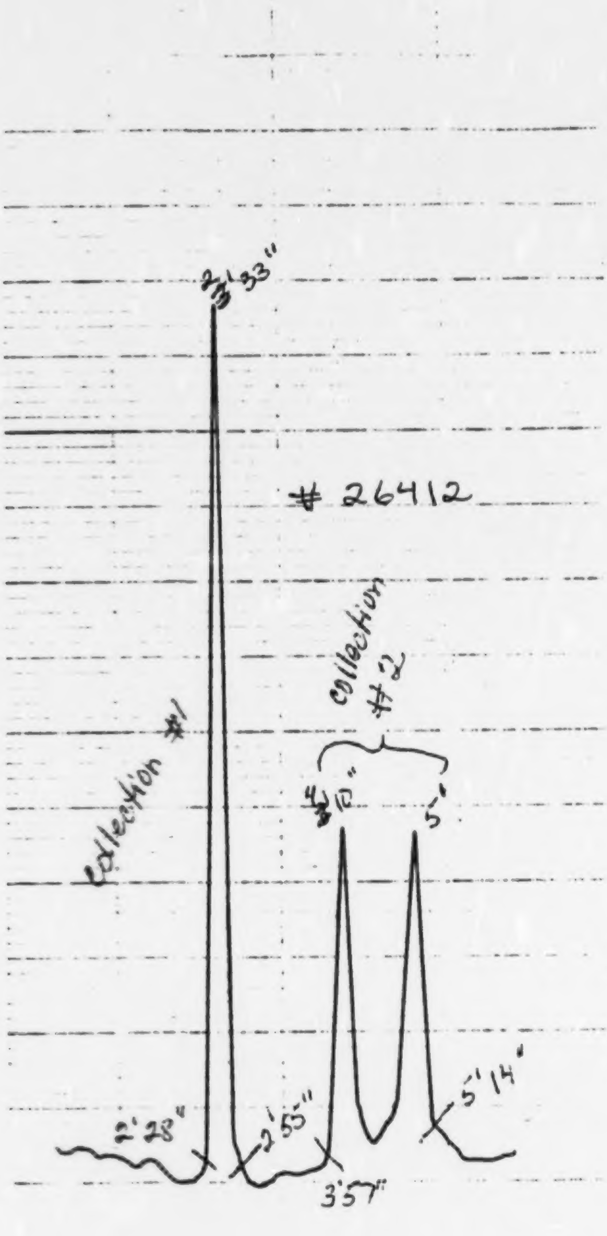
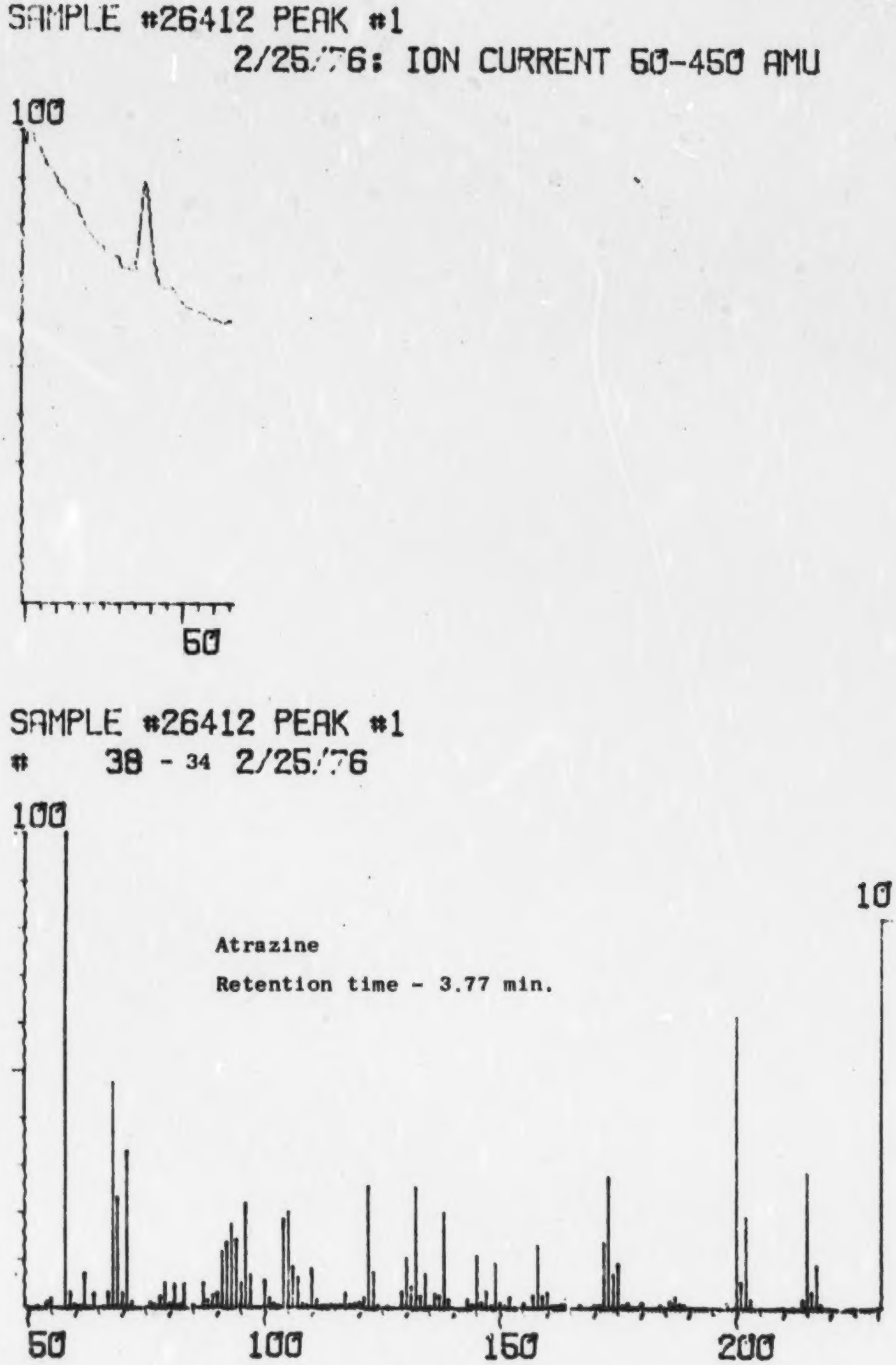


Figure 45 Fraction Collection Gas Chromatogram



Atrazine

Retention time - 3.77 min.

Figure 46 Ion Current Chromatogram and Mass Spectrum of Atrazine-Fraction No. 1, Sample No. 26412

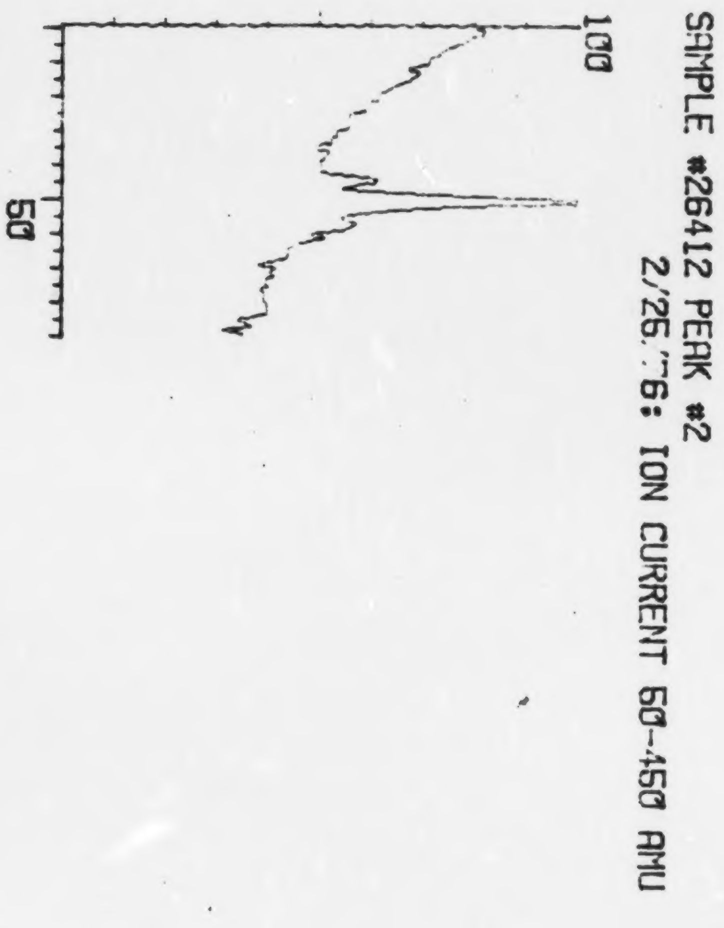
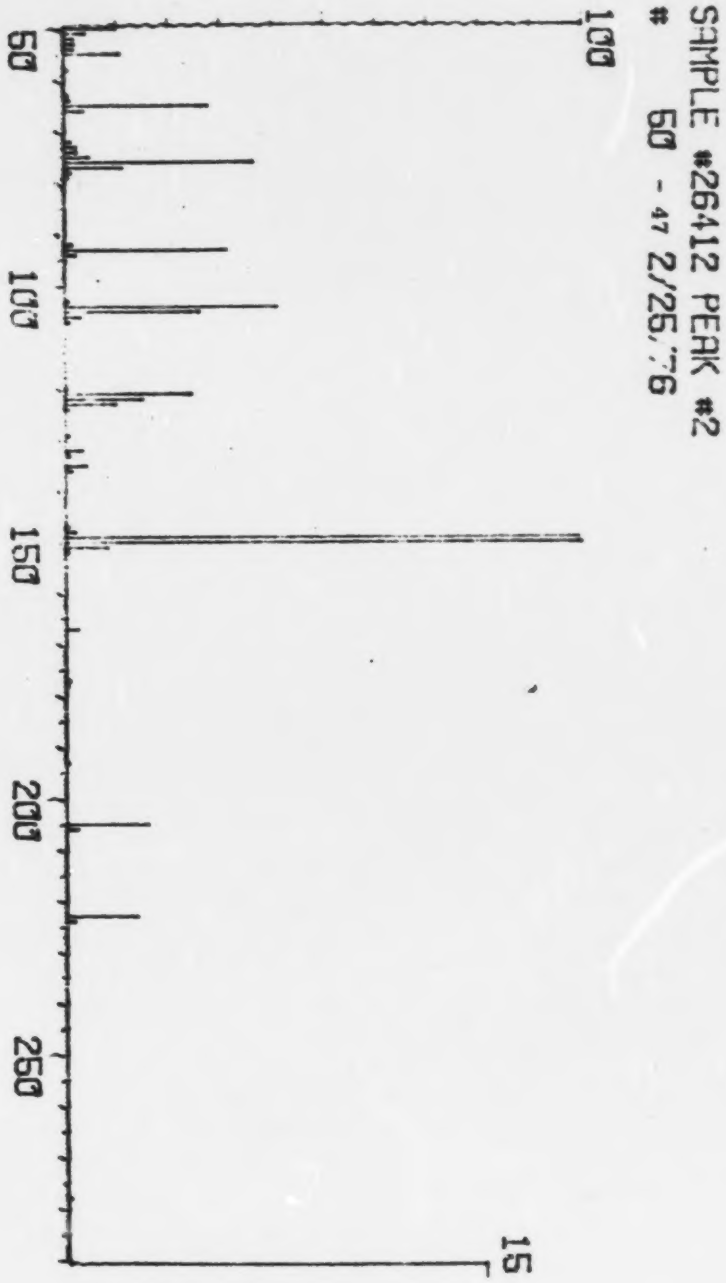


Figure 47 Ion Current Chromatogram, Fraction No. 2, Sample No. 26412



Dibutyl phthalate
Retention time - 4.17 min.
Normalized to m/e 150

Figure 48 Mass Spectrum of Dibutyl Phthalate, Fraction No. 2, Sample No. 26412

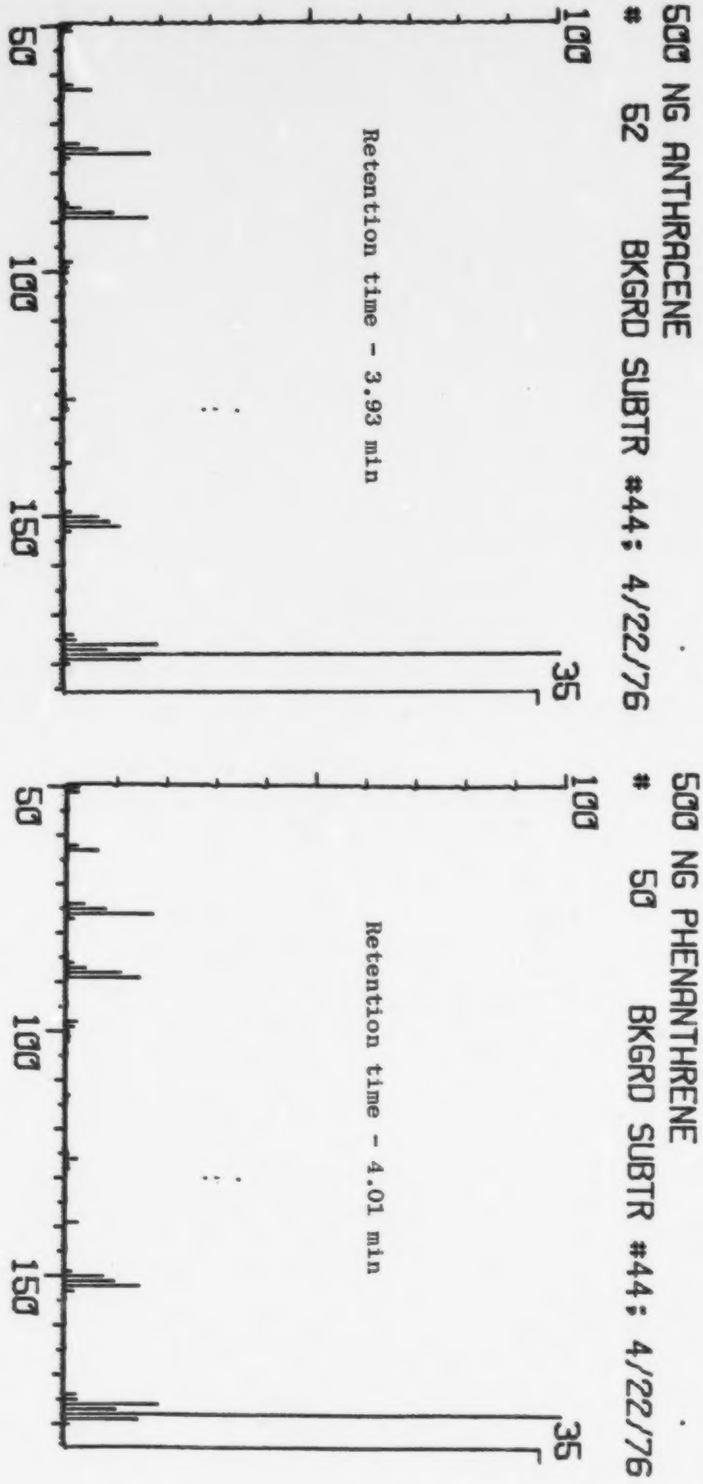


Figure 49 Standard Mass Spectra-Anthracene and Phenanthrene

692

(Registry of Mass Spectral Data, E. Stenhagen, S. Abrahamsson, F. W. McLafferty, John Wiley & Sons, 1974)

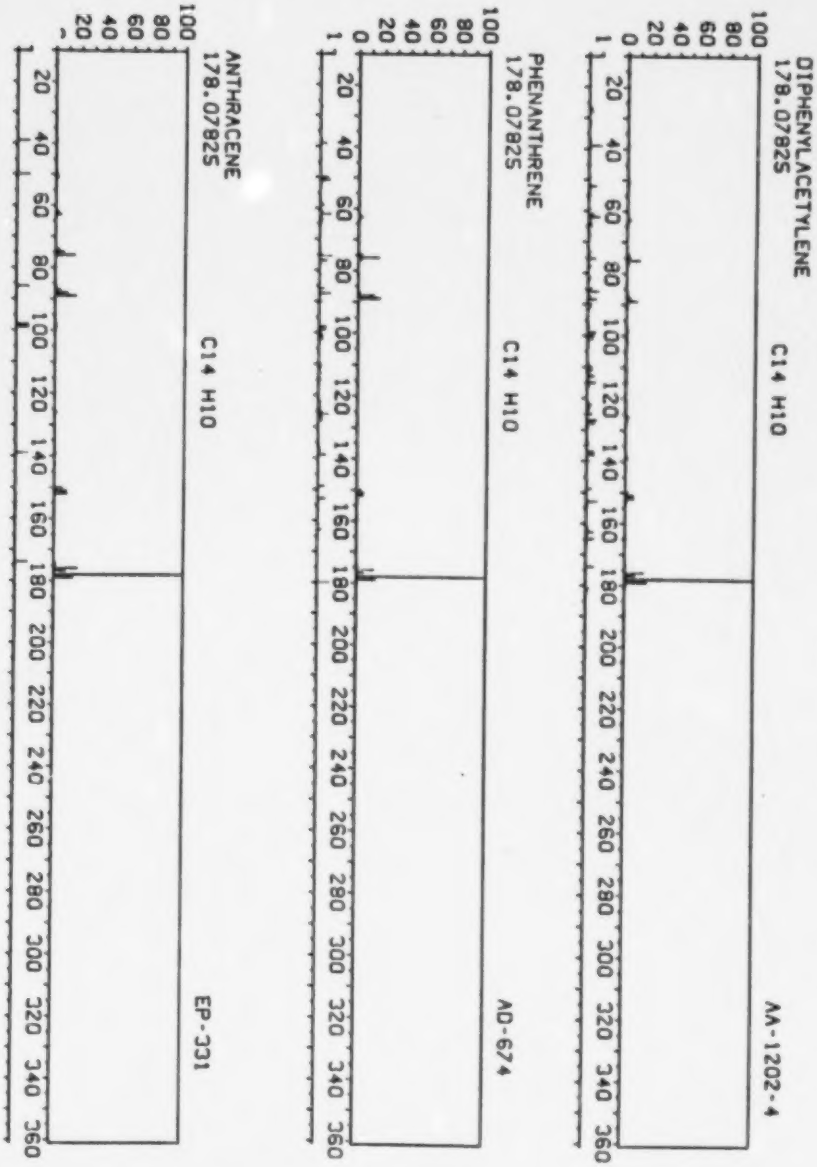
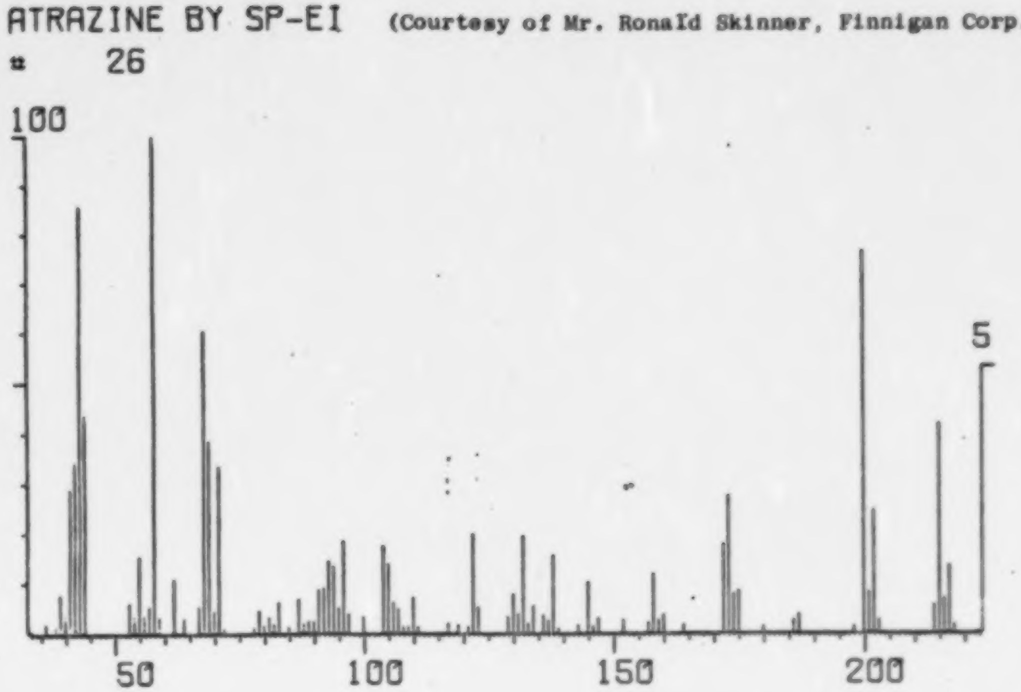
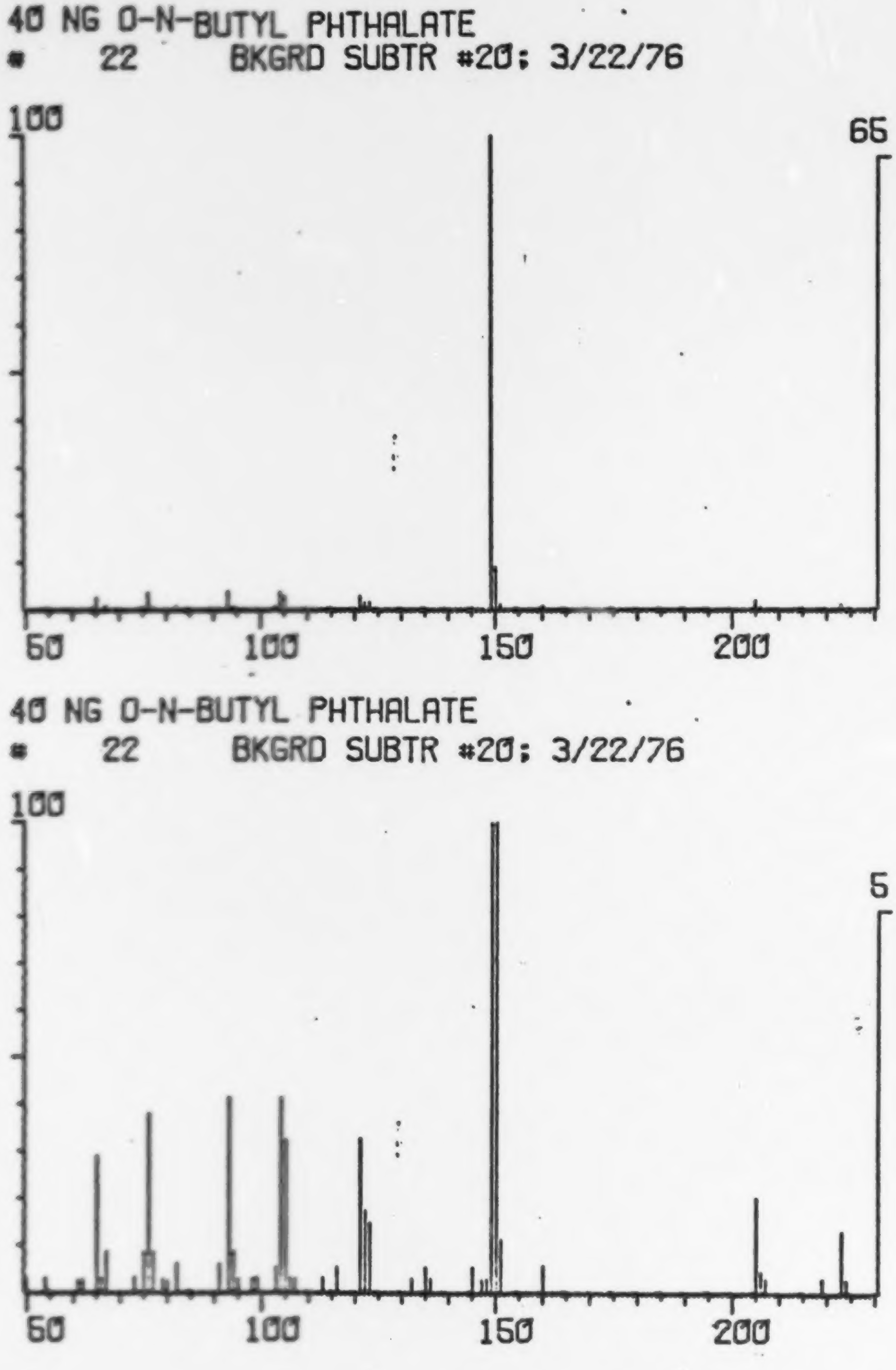


Figure 50 Standard Mass Spectra-Anthracene, Phenanthrene, and Diphenylacetylene



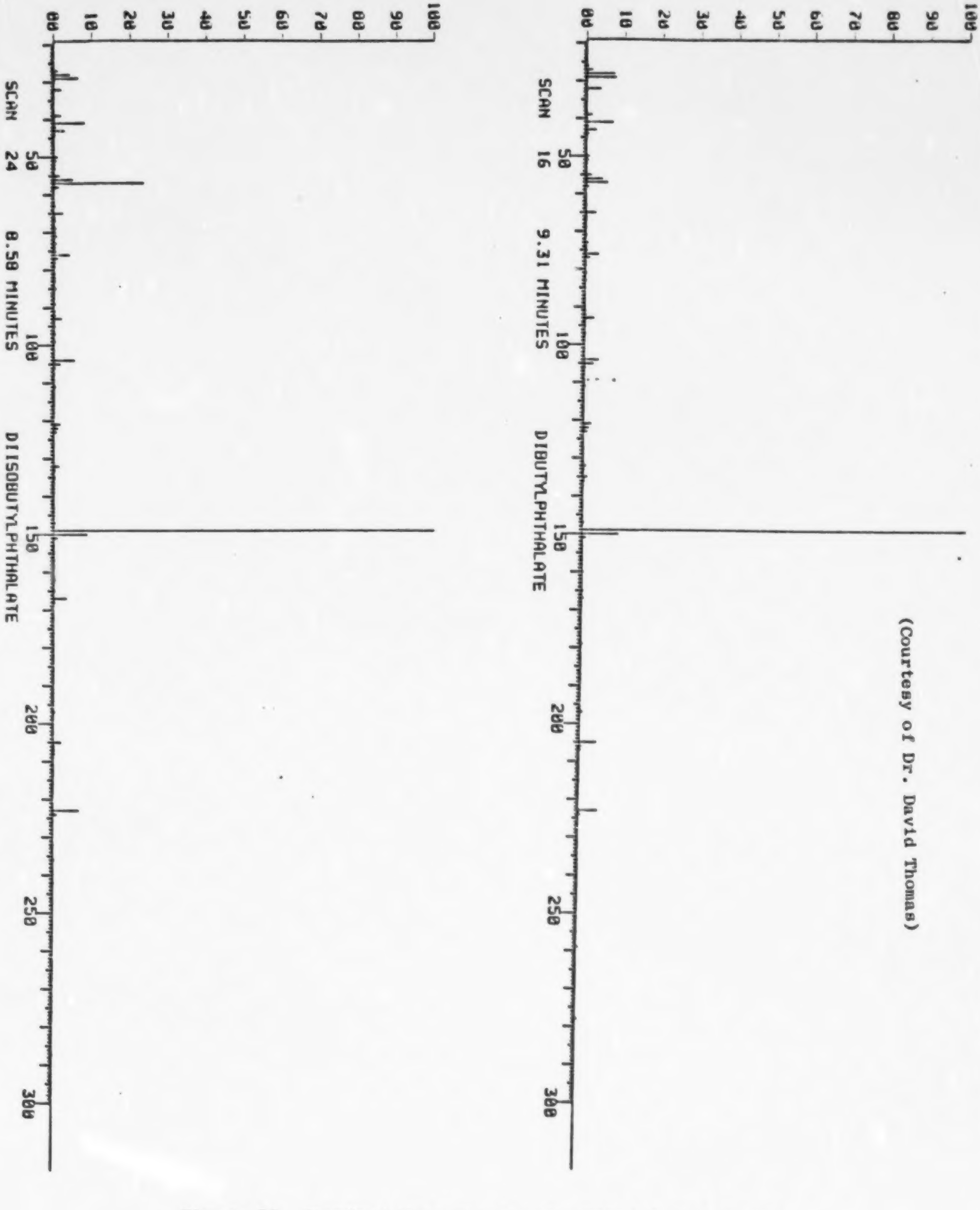
(Courtesy of Mr. Ronald Skinner, Finnigan Corp.)

Figure 51 Standard Mass Spectrum-Atrazine



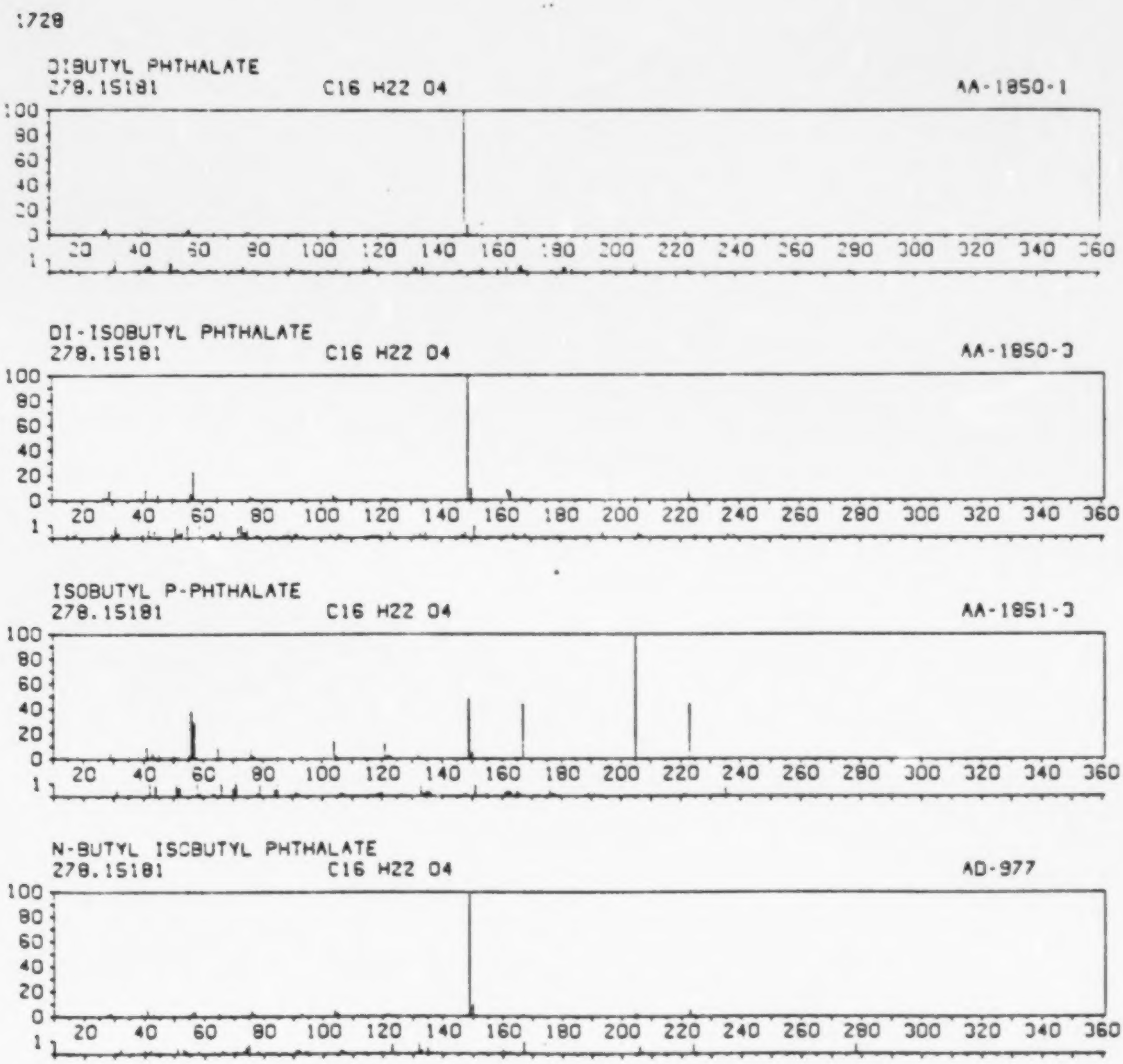
normalized to m/e 150

Figure 52 Standard Mass Spectra-o-n-Dibutyl Phthalate



(Courtesy of Dr. David Thomas)

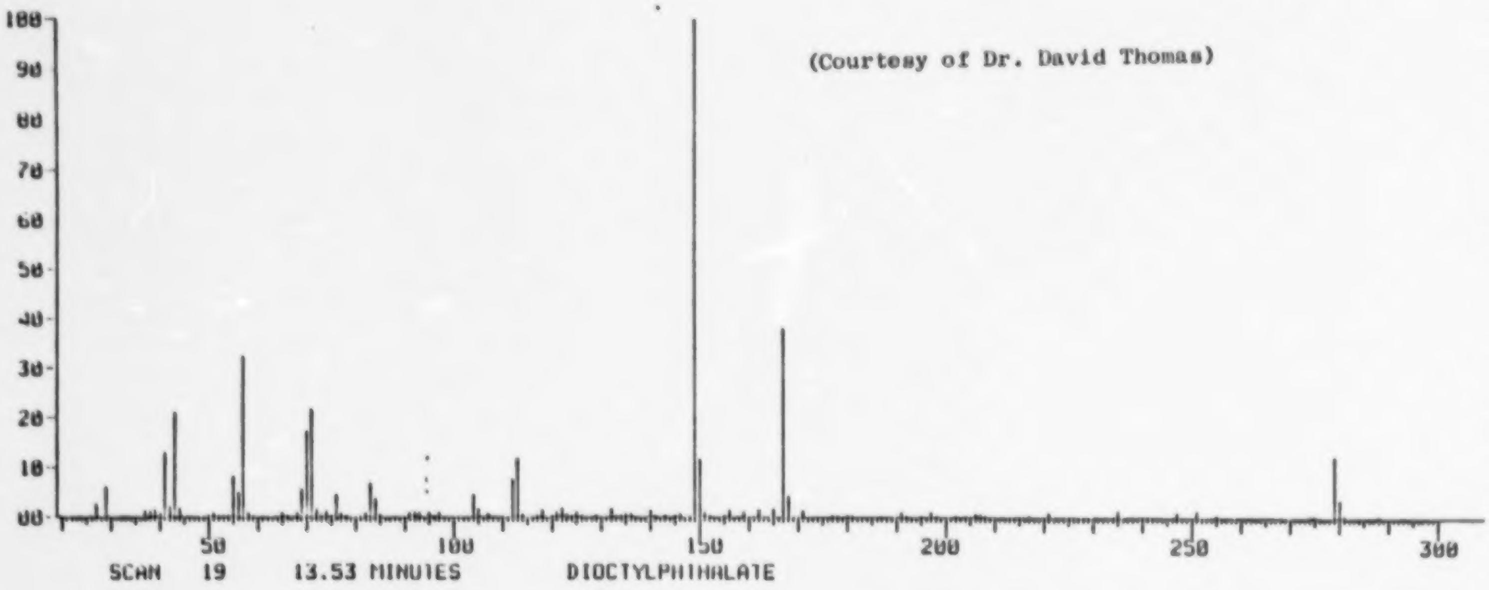
Figure 53 Standard Mass Spectra-Two Dibutyl Phthalates



Registry of Mass Spectral Data, E. Stenhagen, S. Abrahamsson F. W. McLafferty, John Wiley & Sons, 1974.

Figure 54 Standard Mass Spectra-Various Dibutyl Phthalates

10



(Courtesy of Dr. David Thomas)

(Registry of Mass Spectral Data, E. Stenhagen, S. Abrahamsson, F. W. McLafferty, John Wiley & Sons, 1974)

1237

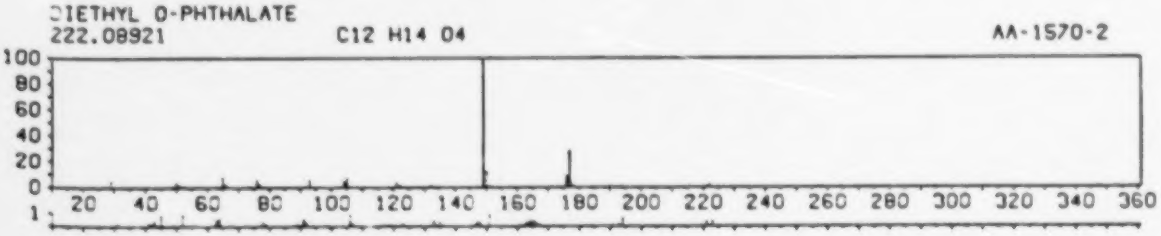


Figure 55 Standard Mass Spectra-Dioctyl Phthalate and Diethyl Phthalate

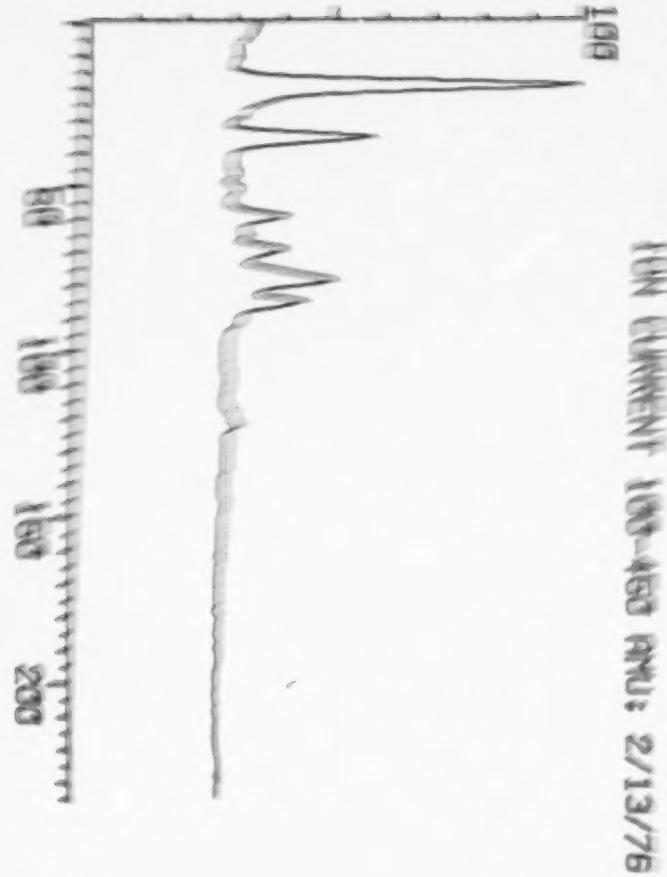
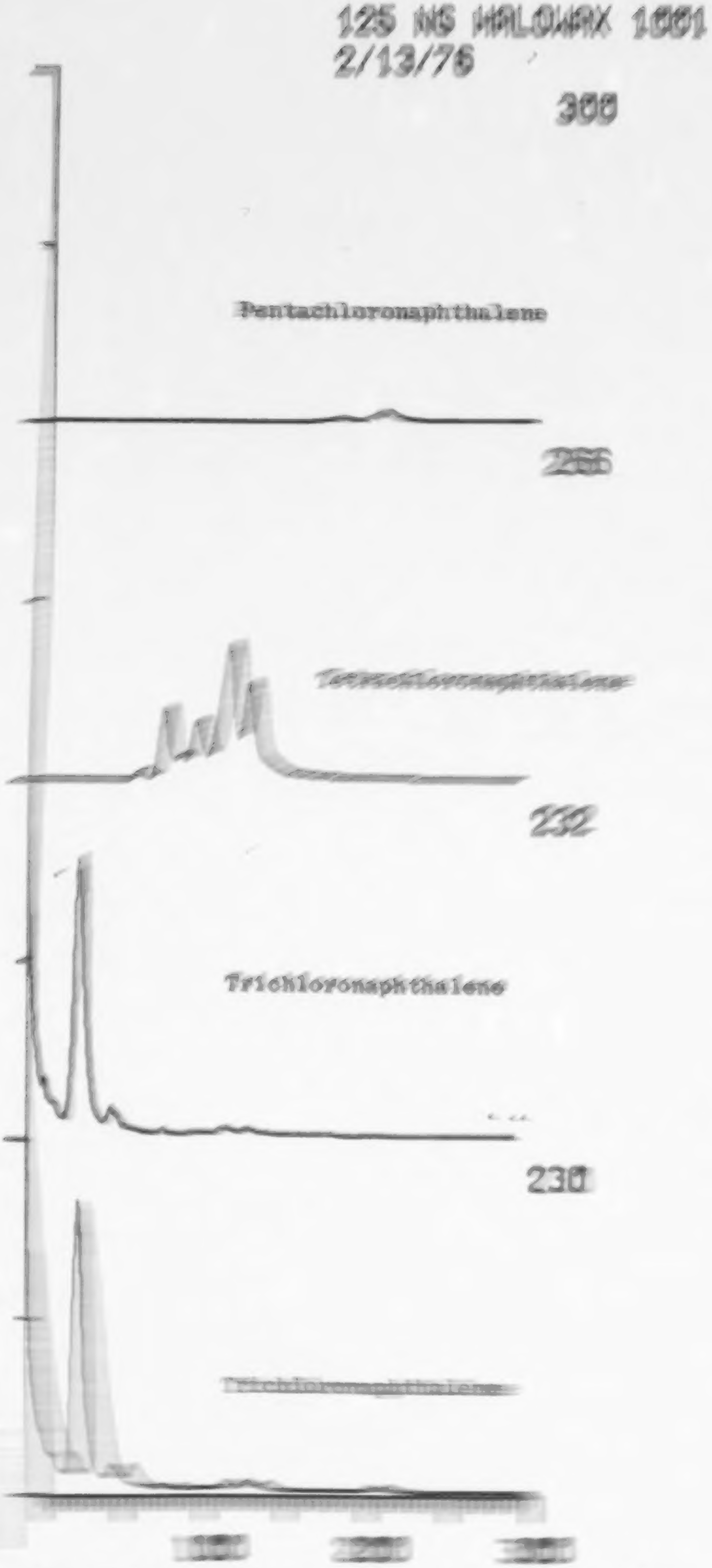
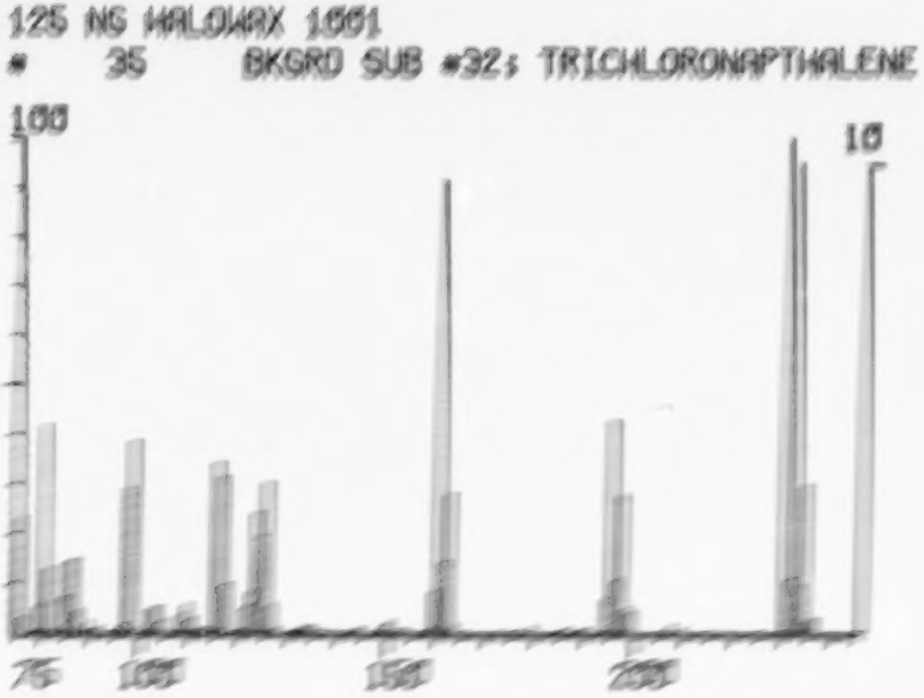


Figure 56. Standard Ion Current Chromatogram, Halowax 1001 (PCN)


125 NG HALOWAX 1001
2/13/76
300
Pentachloronaphthalene
266
Tetrachloronaphthalene
232
Trichloronaphthalene
230
Trichloronaphthalene
100
200
300

[illegible]



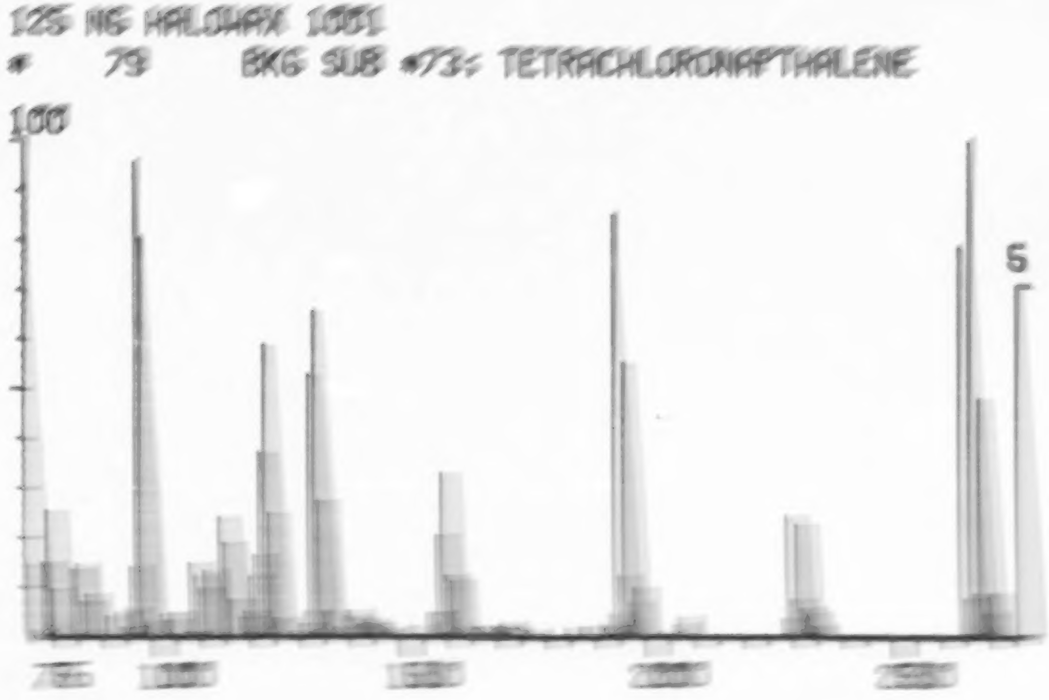


Figure [illegible]. Standard Mass Spectra of Trichloronaphthalene and Tetrachloronaphthalene

(Bulletin of Environmental Contamination and Toxicology 7, No. 4, 1972 (243-249), Chlorinated Naphthalenes in Pesticide Analysis, D. F. Goerlitz and L. M. Law)

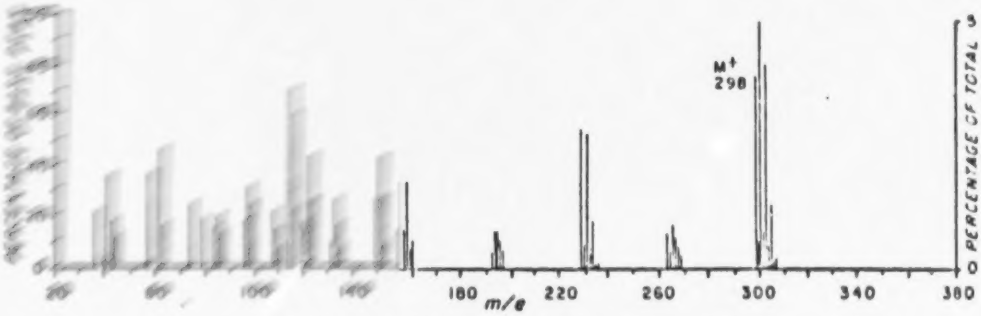
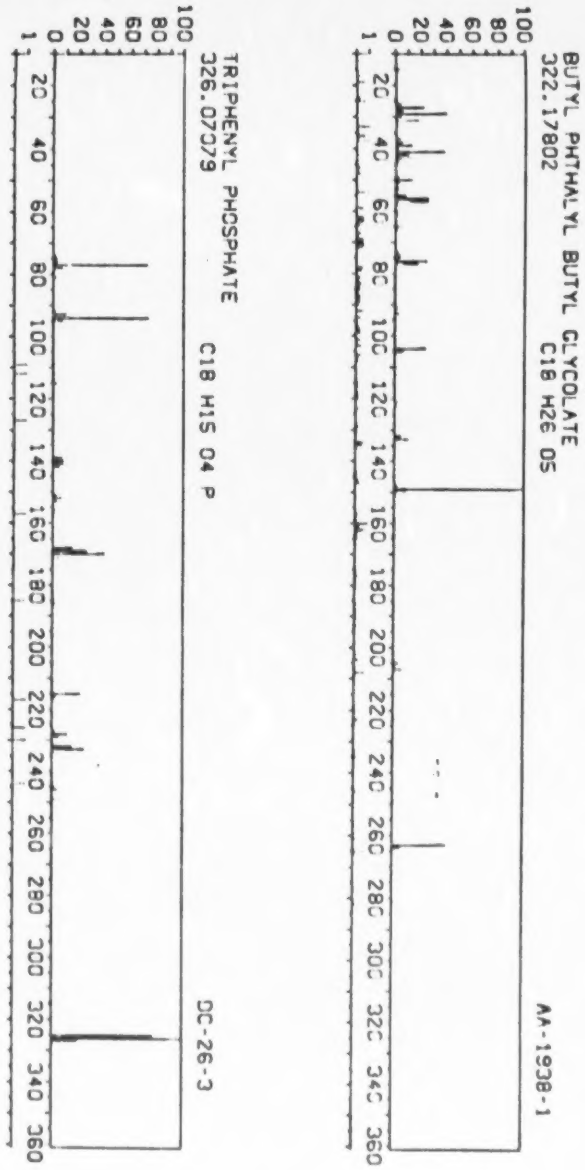


Figure 5. Mass spectrum of a pentachloronaphthalene

Figure 59 Standard Mass Spectrum of Pentachloronaphthalene



Registry of Mass Spectral Data, E. Stenhagen, S. Abrahamsson, F. W. McLafferty, John Wiley & Sons, 1974.

Figure 60 Standard Mass Spectra of Butyl Phthalyl Butyl Glycolate and Triphenyl Phosphate

V DISCUSSION

A. Pesticides

A total of 715 samples of raw and finished drinking water were analyzed for the presence of aldrin, dieldrin, DDT, and DDT metabolites. Dieldrin was found in 94 samples at concentration levels of 4 ppt (minimum level of detection) to 10 ppt; 13 with levels of 11-20 ppt; 4 with levels of 21-29 ppt; and 6 with levels from 56-110 ppt. These 6 samples represented 3 raw and 3 finished waters from one location. Of these 6 samples, 3 also contained aldrin with concentrations between 5-18 ppt. DDT at levels between 10-28 ppt was found in 6 other dieldrin-containing samples. DDT only at 15 and 32 ppt was found in 2 samples. All samples indicated by EPA to have been dosed with known amounts of pesticides were omitted from this enumeration.

By way of a regular quality control system maintained throughout the program, we conducted daily checks on the condition of the gas chromatographic column and the instrumentation. We also made daily linearity checks by alternately injecting standards and samples. Peak heights of samples and standards used for quantitation were matched as closely as possible. Recovery checks of dosed water samples were also made at intervals during the program. These results are listed in Table II.

B. Identification of Unknown Contaminants by GC/MS

The collected fractions of samples were based on the retention time of halogenated compounds as observed with the electrolytic conductivity detector, but besides dieldrin, atrazine and the PCNs were the only halogenated compounds identified. Collections were made from several extracts, each of which had a large peak with a retention time similar to aldrin but were found not to be aldrin by gc/ms fragmentation analysis. In each case in the gc/ms run, the halogenated compound was completely masked by the presence of large amounts of dibutyl phthalate. Identification of the halogenated material by manipulation of the gc/ms data was unsuccessful. Standards of aldrin and o-n-dibutyl phthalate were run on a 5% SE-30 column using an electron capture detector and were found to have

Table II

RECOVERY DATA ON DOSED SAMPLES

GC

	Aldrin		Dieldrin		DDT	
Date	Dose Level (ppt)	Recovery (%)	Dose Level (ppt)	Recovery (%)	Dose Level (ppt)	Recovery (%)
3-24-75	100	81	--	--	100	97
3-25-75	50	74	--	--	50	96
3-26-75	50	87	10	100	50	105
5-21-75	20	80	4	100	20	126
6-16-75	20	66	4	90	20	114
6-16-75	20	75	4	100	20	138
8-19-75	5	100	4	71	--	--
8-26-75	20	70	8	100	20	110
9-12-75	20	65	8	84	20	116
10-28-75	20	83	8	93	20	128
10-28-75	20	85	8	95	20	102
10-28-75	20	86	8	107	20	110
10-28-75	20	91	8	107	20	135
Mean		80.23		95.18		114.75
Standard deviation		10.09		10.55		14.22
Coefficient of variation		13%		11%		12%
GC/MS Finnigan Model 3200						
8-19-75	5	50	4	60	--	--
8-26-75	20	65	8	88	20	115
9-12-75	20	67	8	88	20	113
10-28-75	20	89	8	85	20	99
10-28-75	20	92	8	101	20	119
10-28-75	20	94	8	110	20	125
10-28-75	20	93	8	112	20	126
Mean		78.57		92		116.17
Standard deviation		17.65		17.84		9.89
Coefficient of variation		22%		19%		9%
LKB 9000						
3-24-75	--	--	20	97	--	--
3-25-75	--	--	20	90	--	--
10-28-75	20	58	8	125	20	62
10-28-75	20	83	8	120	20	120
10-28-75	20	69	8	139	20	118
Mean		70		114.2		100
Standard deviation		12.53		20.29		32.92
Coefficient of variation		18%		18%		33%

similar retention times. A check of the behavior of o-n-dibutyl phthalate using the electrolytic conductivity detector was made by injecting several micrograms into the system. This detection system did not respond to the phthalate. Because of contributions from the background material contributed by our samples in the gc/ms runs, no attempt has been made to identify any particular butyl phthalate.

Our finding of atrazine in a large number of samples is supported by a recently reported[5] study of atrazine, DDE, and dieldrin in surface, subsurface, and treated water samples from throughout Iowa. In that study, all three compounds were found in every major watershed in the state, but atrazine levels were highest. Water from shallow wells and finished water were also contaminated. Our Sample 22504 came from Lamoni, Iowa.

Among the contaminants identified in our study of extracts from seven water samples were tri-, tetra-, and pentachlorinated naphthalene isomers, as well as anthracene (phenanthrene) and butyl phthalyl butyl glycolate. None of these compounds is included on the list of 287 Organic Compounds Identified in Drinking Water in the United States received from the Health Effects Research Laboratory, Environmental Protection Agency, Cincinnati, Ohio, dated 1 January 1976.

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APPENDIX

This appendix includes a listing of the pesticide residues found in the water samples submitted to SRI for analysis. Only the results at or above the minimum level of detection are reported. These levels were 1 ppt for dieldrin, 5 ppt for heptachlor epoxide and γ-chlordane, and 10 ppt for aldrin, for DDT and DDT metabolites, and for heptachlor. Those samples marked with an asterisk (*) were selected to be analyzed for heptachlor, heptachlor epoxide, and γ-chlordane.

Included are also copies of all positive gas chromatographic curves, a representative negative curve, and curves obtained from a set of standards of varying concentration.

Table III

PESTICIDE RESIDUES FOUND IN WATER

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Alabama						
Chambers	25204	City of Lafayette Water Works	Finished			
Chambers	25203	City of Lafayette Water Works	Raw			
Jackson	25201	Bridgeport Utility Board, Water Dept.	Raw			
Jackson	25202	Bridgeport Utility Board, Water Dept.	Finished			
Baldwin	25208	Fairhope City Water Dept.	Finished			
Baldwin	25207	Fairhope City Water Dept.	Raw			
Morgan	25206	Decatur Water Dept.	Finished		10	
Morgan	25205	Decatur Water Dept.	Raw			
Colbert	25209	Sheffield; Power Water & Gas Dept.	Raw		7	
Colbert	25210	Sheffield; Power Water & Gas Dept.	Finished			
Alaska						
Sitka	22663	Sitka	Finished			
Sitka	22690	Sitka	Raw			
Anchorage	22687	Anchorage	Finished			
Anchorage	22712	Anchorage	Raw			
Ketchikan	22706	Ketchikan	Raw			
Ketchikan	22680	Ketchikan	Finished			
Arizona						
Gila	23166	Kables Ranch	Raw			
Gila	23167	Kables Ranch	Finished			
Apache	23168	Hawley Lake	Raw			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Arkansas						
Pulaski	22004	Little Rock, Municipal Water Dept.	Raw			
Pulaski	22005	Little Rock, Municipal Water Dept.	Finished			
Hot Spring	22003	Jones Mill Water System	Finished			
Hot Spring	22002	Jones Mill Water System	Raw		5	
Clark	22001	Arkadelphia Water Dept.	Finished			
Clark	22000	Arkadelphia Water Dept.	Raw		6	
Sebastian	22017	Fort Smith Water Dept.	Raw			
Sebastian	22018	Fort Smith Water Dept.	Finished			
Benton	22015	Lowell, Beaver Water District	Raw			
Benton	22016	Lowell, Beaver Water District	Finished		5	
Independence	22019	Batesville Water Dept.	Raw		13	11
Independence	22020	Batesville Water Dept.	Finished		9	
Lawrence	22021	Imboden Water Supply	Raw		4	
Lawrence	22022	Imboden Water Supply	Finished		6	
California						
Los Angeles	23099	Los Angeles Dept. Water & Power	Raw			
Los Angeles	23101*	Los Angeles Dept. Water & Power	Finished			
Los Angeles	23100	Alhambra Public Works Dept.	Raw			
Los Angeles	23102	Alhambra Public Works Dept.	Finished			
San Bernardino	23104	Lake Arrowhead, Arrowhead Utility Co.	Raw			
San Bernardino	23105	Lake Arrowhead, Arrowhead Utility Co.	Finished			
Riverside	23103	Indio, City Water Dept.	Raw			
Merced	23113	Dos Palos Municipal Water Dept.	Finished			
Merced	23114	Dos Palos Municipal Water Dept.	Raw		6	
Santa Cruz	23118	Davenport Water System; Santa Cruz County Public Works Dept.	Finished			
Santa Cruz	23117	Davenport Water System; Santa Cruz County Public Works Dept.	Raw		6	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
California						
Monterey	23119	Soledad	Raw			
Contra Costa	23133	Concord, Contra Costa City Water Dept.	Raw			
Contra Costa	23134	Concord, Contra Costa City Water Dept.	Raw			
Fresno	23130	Coalinga	Finished		5	
Fresno	23129	Coalinga	Finished			
San Diego	23127	San Diego Utility Dept.	Raw			
San Diego	23126	San Diego Utility Dept.	Finished		4	
Tulare	23131	Visalia, Damsen Water Co.	Raw		5	
San Diego	23125	Otay Municipal Water Dept., Spring Valley	Raw		6	
San Diego	23128	Otay Municipal Water Dept., Spring Valley	Finished			
San Francisco	23120	San Francisco Water Dept.	Finished			
Tuolumne	23123	San Francisco Water Dept., Moccasin Reservoir	Raw			
Stanislaus	23121	Turlock Irrigation District, LaGrange System	Raw			
Stanislaus	23122	Turlock Irrigation District. LaGrange System	Finished			
Calaveras	23124	Union Public Utility District, Murphys	Raw			
Calaveras	23132	Union Public Utility District Murphys	Finished			
Solano	23139	Vallejo	Finished			
Solano	23138	Vallejo	Raw			
Contra Costa	23115	Pleasant Hill	Raw			
Contra Costa	23116	Pleasant Hill	Finished		12	
Contra Costa	23135	Bethel Island; Pleasant Times Water Co.	Raw			
Contra Costa	23137	Pittsburg	Finished			
Contra Costa	23136	Pittsburg	Raw			
Marin	23140	Fairfax; Marin Municipal Water District	Raw			
Marin	23141	Fairfax; Marin Municipal Water District	Finished			
Sonoma	23142	Bodega Bay; Carmet-by-the-Sea Mutual Water Co.	Raw		5	
Sonoma	23143	Bodega Bay; Carmet-by-the-Sea Mutual Water Co.	Finished			
Alameda	23144	Oakland; East Bay M.U.D.	Raw		8	
Alameda	23145	Oakland; East Bay M.U.D.	Finished		6	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
California						
El Dorado	23146	Placerville; El Dorado Irrigation District	Raw		16	
El Dorado	23147	Placerville; El Dorado Irrigation District	Finished			
El Dorado	23148	Georgetown; Georgetown Divide PUD	Raw			
El Dorado	23149	Georgetown; Georgetown Divide PUD	Finished			
Sutter	23152	Yuba City; Water Dept.	Raw			
Sutter	23153	Yuba City; Water Dept.	Finished			
Nevada	23150	Grass Valley; Nevada Irrigation District	Raw			
Nevada	23151	Grass Valley; Nevada Irrigation District	Finished			
Sacramento	23154	Sacramento	Raw			
Sacramento	23155	Sacramento	Finished			
Sacramento	23156	Mather A.F.B.	Raw			
Sacramento	23157	Mather A.F.B.	Finished			
Fresno	23172	North Fork; Minarets Work Center Water Supply	Raw			
Fresno	23173	North Fork; Minarets Work Center Water Supply	Finished			
Colorado						
Boulder	22606	Boulder, Betasso Water Filtration Plant	Finished			
Boulder	22657	Boulder, Betasso Water Filtration Plant	Raw		8	
Yuma	22614	Wray Municipal Water Supply	Raw			
Yuma	22584	Wray Municipal Water Supply	Finished			
Boulder	22574	Longmont Water Filtration Plant, North	Finished			
Boulder	22613	Longmont Water Filtration Plant, North	Raw			
Larimer	22628	Fort Collins, Poudre Canyon Plant	Raw			
Larimer	22601	Fort Collins, Poudre Canyon Plant	Finished			
Montrose	22615	Montrose City	Raw			
Montrose	22600	Montrose City	Finished			
Arapahoe	22618	Aurora, Aurora Kulper Water Treatment Plant	Raw			
Arapahoe	22607	Aurora, Aurora Kulper Water Treatment Plant	Finished			
Denver	22617	Denver, Moffat Treatment Plant	Raw			
Denver	22605	Denver, Moffat Treatment Plant	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Colorado						
La Plata	22616	Durango	Raw			
La Plata	22602	Durango	Finished			
Pueblo	31258	Pueblo	Raw			
Pueblo	22604	Pueblo	Finished			
Connecticut						
Hartford	25067	Manchester	Raw			
Hartford	25068	Manchester	Finished			
Tolland	25063	Somers; Connecticut Correctional Institute/Men	Raw			
Tolland	25064	Somers; Connecticut Correctional Institute/Men	Finished			
Middlesex	25069	East Hampton; Edgemere Hills Apartments	Raw			
New Haven	25070	Meriden	Raw			
New Haven	25071	Meriden	Finished			
Litchfield	25072	Winsted	Raw			
Litchfield	25073	Winsted	Finished			
Fairfield	25029	Greenwich	Raw			
Fairfield	25030	Greenwich	Finished			
Tolland	25074	Rockville	Raw			
Tolland	25032	Rockville	Finished			
Florida						
Palm Beach	25268	West Palm Beach	Finished			
Palm Beach	25267	West Palm Beach	Raw			
Palm Beach	25271	Belle Glade	Raw			
Palm Beach	25272	Belle Glade	Finished			
Lee	25265	Ft. Myers; Lee County Utility Dept.	Raw			
Lee	25266	Ft. Myers; Lee County Utility Dept.	Finished			
Hardee	25269	Bowling Green	Raw			
Hardee	25270	Bowling Green	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Georgia						
De Kalb	25263	Decatur; De Kalb County Water & Sewer System	Raw			
De Kalb	25264	Decatur; De Kalb County Water & Sewer System	Finished			
Pickens	25256	Jasper	Finished			
Pickens	25255	Jasper	Raw			
Polk	25258	Rockmart	Finished			
Polk	25257	Rockmart	Raw			
Muscogee	25259	Columbus	Raw			
Muscogee	25260*	Columbus	Finished			
Dougherty	25261	Albany	Raw			
Dougherty	25262	Albany	Finished			
Hawaii						
--	23109	Honolulu; Kalihi Shaft	Raw			
--	23108	Honolulu; Kalihi Shaft	Finished			
Hawaii	23107	Waimea; Hamakua Water System	Raw			
Hawaii	23106	Waimea; Hamakua Water System	Finished			
Idaho						
Ada	22728	Boise	Raw			
Ada	22727	Boise	Finished			
Bonneville	22723	Idaho Falls	Finished			
Bonneville	22724	Idaho Falls	Raw			
Nez Perce	22730	Lewiston Orchards	Raw			
Nez Perce	22729	Lewiston Orchards	Finished		4	
Illinois						
Washington	26568	Nashville Public Water Supply	Raw		20	
Washington	26567	Nashville Public Water Supply	Finished		9	
St. Clair	26565	East St. Louis; East St. Louis & Interurban W.S.	Raw		8	
St. Clair	26566*	East St. Louis; East St. Louis & Interurban W.S.	Finished		6	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)		Dieldrin (ppt)		DDT (ppt)
Illinois								
Champaign	11044	Ludlow	Raw					
Champaign	11045	Ludlow	Finished					
Adams	26575	Quincy	Raw			5		
Adams	26574*	Quincy	Finished			7		
Cook	26582	Northbrook	Raw					
Cook	26581	Northbrook	Finished	#1	#2	#1	#2	
Macoupin	26577 X2	Gillespie	Raw	15	18	80	110	
Macoupin	26576 X2	Gillespie	Finished		5	60	90	
Fulton	26584	Canton	Raw			6		
Fulton	26583	Canton	Finished			5		
Macon	26407*	Decatur	Finished			22		
Macon	26408	Decatur	Raw			26		
Macoupin	26426*	Gillespie	Raw	13		56		
Macoupin	26425	Gillespie	Finished			63		
Lake	26402	Waukegon	Raw					
Lake	26401	Waukegon	Finished					
Indiana								
Henry	26569	New Castle	Raw					
Henry	26570	New Castle	Finished					
Dubois	11042	Jasper	Raw			4		
Dubois	11043	Jasper	Finished					
Spencer	26572	Chrisney	Finished					
Spencer	26571	Chrisney	Raw					
Iowa								
Woodbury	22459	Sioux City Water Dept.	Raw					
Woodbury	22460	Sioux City Water Dept.	Finished					

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Iowa						
--	22509	Dubuque	Raw			
--	22510	Dubuque	Finished			
Decatur	22503*	Lamoni	Raw		7	
Decatur	22504	Lamoni	Finished			
Polk	22505	Des Moines	Raw			
Polk	22506	Des Moines	Finished		4	
Cerro Gordo	22508	Clearlake	Finished			
Cerro Gordo	22507 #1*	Clearlake	Raw		4	
Cerro Gordo	22507 #2*	Clearlake	Raw			
--	22515	Mystic	Raw		4	
--	22516	Mystic	Finished		5	
Des Moines	22513*	Burlington	Raw			
Des Moines	22514*	Burlington	Finished		9	
Scott	22511*	Davenport	Raw		11	
Scott	22512*	Davenport	Finished		4	
Kansas						
Atchison	22461	Atchison City Water Works, Inc.	Raw		7	
Atchison	22462	Atchison City Water Works, Inc.	Finished			
Mitchell	22489	Glen Elder	Raw			
Mitchell	22490	Glen Elder	Finished			
Shawnee	22487	Topeka	Raw			
Shawnee	22488	Topeka	Finished			
Cowley	22527	Winfield	Raw			
Cowley	22526	Winfield	Finished			
Lyon	22497	Olpe	Raw			
Lyon	22498	Olpe	Finished			
Morris	22499	Council Grove	Raw			
Morris	22500	Council Grove	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Kansas						
Osage	22501	Vassar; Pomona State Park	Raw		4	
Osage	22502	Vassar; Pomona State Park	Finished			
Wyandotte	22517	Kansas City	Raw			
Wyandotte	22518	Kansas City	Finished		12	
Labette	22519*	Parsons	Raw		8	
Labette	22520	Parsons	Finished			
Cherokee	22521	Weir	Raw			
Cherokee	22522	Weir	Finished			
Kentucky						
Boyd	25216*	Ashland Water Works	Finished			
Boyd	25215	Ashland Water Works	Raw			
Jefferson	25219	Louisville Water Company	Raw		7	
Jefferson	25220*	Louisville Water Company	Finished			
Estill	25212	Irvine Municipal Utilities	Finished		4	
Estill	25211	Irvine Municipal Utilities	Raw			
Daviess	25217	Owensboro Municipal Utilities	Raw			
Daviess	25218	Owensboro Municipal Utilities	Finished			
Shelby	25214	Shelbyville Municipal Water & Sewer Comm.	Finished		6	
Shelby	25213	Shelbyville Municipal Water & Sewer Comm.	Raw		4	
Powell	26173	Furnice	Raw		4 spike	
Powell	26174	Furnice	Finished		6	
Fayette	32901	Lexington; Fayette County Water Supply	Finished			
Fayette	32902	Lexington; Fayette County Water Supply	Raw			
Kenton	32903	Forest Hills; Kenton Water District #1	Finished		6	
Kenton	32904	Forest Hills; Kenton Water District #1	Raw		6	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Louisiana						
Iberia	23011	New Iberia Water Utility	Raw		7	
Iberia	23010	New Iberia Water Utility	Finished		4	
St. Mary	23013	Morgan City Water Supply	Raw		16	
St. Mary	23012	Morgan City Water Supply	Finished		6	
Lafayette	23008	Lafayette Water Utility	Finished		4	
Lafayette	23009	Lafayette Water Utility	Raw			
Tensas	23007	St. Joseph; Lake Bruin District #1	Finished			
Tensas	23006	St. Joseph; Lake Bruin District #1	Raw			
Jefferson	23030*	Marrero; Jefferson Parish W.W.; District #2	Raw			
Jefferson	23029*	Marrero; Jefferson Parish W.W.; District #2	Finished		7	10
St. Tammany	23035	Covington	Raw			
St. Tammany	23036	Covington	Finished			
Plaquemines	23031	Buras; Empire Water Works	Raw			
Plaquemines	23032	Buras; Empire Water Works	Finished			
St. John the Baptist	23034*	Godchaux Sugars; Reserve	Raw			
St. John the Baptist	23033	Godchaux Sugars; Reserve	Finished			
Maine						
Cumberland	25034	Portland	Raw			
Cumberland	25035	Portland	Finished			
Franklin	25054	Rangeley	Raw			
Franklin	25053	Rangeley	Finished			
Aroostook	25038	Caribou	Raw			
Aroostook	25037	Caribou	Finished			
Waldo	25078	Searsport	Finished			
Waldo	25077	Searsport	Raw			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Maine						
York	25049	Kennebunk	Raw			
York	25050	Kennebunk	Finished			
Penobscot	25075	Millinocket	Raw			
Penobscot	25076	Millinocket	Finished			
Oxford	25051	Dixfield	Raw			
Oxford	25052	Dixfield	Finished			
Aroostook	25040	Presque Isle	Finished		4	
Aroostook	25039	Presque Isle	Raw			
Maryland						
Worcester	22939	Ocean City; 15th St. Plant	Raw			
Worcester	22943	Ocean City; 15th St. Plant	Finished			
Dorchester	22941	Secretary	Raw			
Dorchester	26358	Secretary	Raw			
Dorchester	26357	Secretary	Finished			
Charles	22935	Waldorf Sanitary District	Raw			
Charles	22936	Waldorf Sanitary District	Finished			
Anne Arundel	22938	Glen Burnie; Anne Arundel Dept. Public Works	Raw			
Anne Arundel	22937	Glen Burnie; Anne Arundel Dept. Public Works	Finished		4	
Carroll	22932	Sykesville; Springfield Hospital Center	Raw			
Carroll	22942	Sykesville; Springfield Hospital Center	Finished		4	
Washington	22933	Greenbriar State Park	Raw			
Washington	22934	Greenbriar State Park	Finished			
Massachusetts						
Essex	25019	Lawrence	Raw			
Essex	25033	Lawrence	Finished			
Middlesex	25020	Boston; Metropolitan District	Raw			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Massachusetts						
Hampden	25024	Westfield	Raw			
Hampden	25023	Westfield	Finished			
Hampden	25025	Ludlow; Springfield Water Dept.	Raw			
Hampden	25026	Ludlow; Springfield Water Dept.	Finished			
Hampden	25027	Chicopee	Raw			
Hampden	25028	Chicopee	Finished			
Plymouth	25031	Wareham	Finished			
Michigan						
Muskegon	26406	Muskegon	Raw			
Muskegon	26405	Muskegon	Finished			
Wayne	26404	Detroit	Finished			
Wayne	26403	Detroit	Raw		5	
Mecosta	26409	Big Rapids	Raw			
Mecosta	26410	Big Rapids	Finished			
Monroe	26411	Dundee	Raw			
Monroe	26412*	Dundee	Finished			
Barry	26413	Middleville	Raw			
Barry	26414	Middleville	Finished			
Ontonagon	26429	Ontonagon	Finished			
Minnesota						
Ramsey	26420	St. Paul	Raw			
Ramsey	26419	St. Paul	Finished			
Olmsted	26418	Rochester	Raw			
Olmsted	26417	Rochester	Finished			
Polk	26428	Crookston	Raw			
Polk	26427	Crookston	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Mississippi						
Hinds	25246	Jackson	Finished			
Hinds	25245	Jackson	Raw			
Lowndes	25243	Columbus; Dept. of Water & Lights	Raw			
Lowndes	25244	Columbus; Dept. of Water & Lights	Finished			
Coahoma	25247	Clarksdale	Raw			
Coahoma	25248	Clarksdale	Finished			
Missouri						
Buchanan	22464*	St. Joseph Water Co.	Finished		8	
Buchanan	22463	St. Joseph Water Co.	Raw		5	
Clay	22491	Kansas City, Water Dept.	Raw			
Clay	22492	Kansas City, Water Dept.	Finished			
--	22468	St. Louis Water Division	Finished		7	
--	22467	St. Louis Water Division	Raw		5	
St. Louis	22466	St. Louis County Water Co.	Finished			
St. Louis	22465	St. Louis County Water Co.	Raw		15	
Piedmont	22469	Piedmont, City Water Dept.	Raw		12	
Piedmont	22470	Piedmont, City Water Dept.	Finished			
Butler	22472	Poplar Bluff Light and Water	Finished			
Butler	22471	Poplar Bluff Light and Water	Raw			
--	22481	Maryville, City Water Utility	Raw			
--	22482	Maryville, City Water Utility	Finished			
--	22475	Rolla	Raw			
--	22476	Rolla	Finished			
Harrison	22477	Blythville; Harrison Co. Mo. PWSD #1	Raw		11	
Harrison	22478	Blythville; Harrison Co. Mo. PWSD #1	Finished		6	
Lafayette	22474	Concordia	Finished			
Lafayette	22473*	Concordia	Raw		5	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Missouri						
--	22483*	Moberly; City Water Dept.	Raw		4	
--	22484	Moberly; City Water Dept.	Finished		4	
--	22485	Kirksville	Raw			
--	22486	Kirksville	Finished			
--	22479	Milan	Raw			
--	22480	Milan	Finished			
Bates	22493	Butler	Raw		7	
Bates	22494*	Butler	Finished		4	
Jasper	22495	Joplin	Raw			
Jasper	22496	Joplin	Finished			
Montana						
Gallatin	22650	Bozeman City Water Works	Raw			
Gallatin	22587	Bozeman City Water Works	Finished			
Pandera	22647	Conrad	Raw			
Pandera	22589	Conrad	Finished			
Ravalli	22645	Hamilton; Valley Water Co.	Raw			
Ravalli	22571	Hamilton; Valley Water Co.	Finished			
Cascade	22651	Great Falls	Raw			
Cascade	22586	Great Falls	Finished			
Yellowstone	22652	Billings	Raw			
Yellowstone	22585	Billings	Finished			
Yellowstone	22646	Laurel	Raw			
Yellowstone	22570	Laurel	Finished			
Silver Bow	22588	Butte	Finished			
Silver Bow	22648	Butte	Raw			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Nebraska						
Douglas	22458	Omaha, Metropolitan Utility District	Finished			
Douglas	22457	Omaha, Metropolitan Utility District	Raw			
Box Butte	22523	Alliance	Raw			
Box Butte	22524	Alliance	Finished			
Nevada						
Clark	23158	Las Vegas	Raw			
Clark	23159	Las Vegas	Finished			
Clark	23162	Henderson	Raw			
Clark	23160	Henderson	Finished			
New Hampshire						
Hillsborough	25041	Manchester	Raw			
Hillsborough	25042	Manchester	Finished			
Grafton	25044	Bethlehem	Raw			
Grafton	25043	Bethlehem	Finished			
Grafton	25045	Woodstock	Raw			
Grafton	25046	Woodstock	Finished			
Grafton	25047	Lisbon	Raw			
Grafton	25048	Lisbon	Finished			
Rockingham	25057	Hampton	Raw			
Rockingham	25058	Hampton	Finished			
New Jersey						
Burlington	25151	Willingsboro	Raw			
Burlington	25150	Willingsboro	Finished			
Salem	25153	Penns Grove	Raw			
Salem	25152	Penns Grove	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
New Jersey						
Mercer	25149	Trenton	Raw			
Mercer	25148	Trenton	Finished			
Middlesex	25145	New Brunswick	Raw			
Middlesex	25144	New Brunswick	Finished			
Sussex	25141	Vernon; Lake Wallkill Community W.S.	Raw			
Sussex	25140	Vernon; Lake Wallkill Community W.S.	Finished			
Morris	25143	Heath Village	Raw			
Morris	25142	Heath Village	Finished			
Passaic	25135	Little Falls; Passaic Valley Water Comm.	Raw		4	
Passaic	25134	Little Falls; Passaic Valley Water Comm.	Finished			
Middlesex	25147	Twp. No. Brunswick	Raw			
Middlesex	25146	Twp. No. Brunswick	Finished			
Morris	25137	Butler	Raw			
Morris	25136	Butler	Finished			
Passaic	25139	Wanaque; No. Jersey District Water Comm.	Raw			
Passaic	25138	Wanaque; No. Jersey District Water Comm.	Finished			
Morris	25155	Boonton; Jersey City Water Dept.	Raw			
Morris	25154	Boonton; Jersey City Water Dept.	Finished			
Middlesex	25176	Kingston	Raw		29	
Middlesex	25177 #1	Kingston	Finished		20	
Middlesex	25177 #2	Kingston	Finished		21	
New York						
Chatauqua	25101	Dunkirk	Raw			
Chatauqua	25102	Dunkirk	Finished			
Erie	25103	Buffalo	Raw			
Erie	25104	Buffalo	Finished			
Yates	25105	Penn Yan	Raw			
Yates	25106	Penn Yan	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
New York						
Ontario	25107	Geneva	Raw			
Ontario	25108	Geneva	Finished			
Oneida	25110	Stokes; Rome Water Dept.	Raw			
Oneida	25109	Stokes; Rome Water Dept.	Finished			
Oneida	25111	Forestport	Raw			
Oneida	25112	Forestport	Finished			
--	25116	Plattsburgh	Raw		5	
--	25113*	Plattsburgh	Finished			
--	25115	Rouses Pt.	Raw			
--	25114	Rouses Pt.	Finished			
--	25118	Keene	Raw			
--	25119	Keene	Finished			
--	25123	Albany	Raw			
--	25124	Albany	Finished			
--	25129	Latham; Mohawk View Treatment Plant	Raw			
--	25128*	Latham; Mohawk View Treatment Plant	Finished			
--	25127	Kingston	Raw			
--	25126	Kingston	Finished			
--	25122	Clifton Park; County Knolls Water Works	Finished			
Nassau	25156	New York City; Jamaica Water Supply Co.	Raw			
Nassau	25157	New York City; Jamaica Water Supply Co.	Finished			
Orange	25178	Sterling Forest-Blue Lake Supply	Raw			
Orange	25179	Sterling Forest-Blue Lake Supply	Finished		4	
Orange	25180	Warwick, West Greenwood Lake	Raw		4	
Orange	25181	Warwick, West Greenwood Lake W.D.	Finished		4	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
North Carolina						
Mecklenburg	25232	Charlotte, City Water Dept.	Finished			
Mecklenburg	25231	Charlotte, City Water Dept.	Raw		5	
Robeson	25230	Lumberton, City Water Dept.	Finished			
Robeson	25229	Lumberton, City Water Dept.	Raw			
Alamance	25226	Mebane; Orange-Alamance Water System	Finished			
Alamance	25225	Mebane; Orange-Alamance Water System	Raw			
Edgecomb	25227	Tarboro Water Dept.	Raw			
Edgecomb	25228	Tarboro Water Dept.	Finished			
Caldwell	25224	Granite Falls, Water Dept.	Finished			
Caldwell	25223	Granite Falls	Raw			
North Dakota						
Bottineau	22637	Westhope Water Department	Raw			
Bottineau	22577	Westhope Water Department	Finished			
Pembina	22638	Cavilier, City Water Department	Raw			
Pembina	22563	Cavilier, City Water Department	Finished		5	
Cass	22578	Fargo, City Water Department	Finished		11	
Cass	22626	Fargo, City Water Department	Raw			
Walsh	22627	Park River, City Water Department	Raw			
Walsh	22576	Park River, City Water Department	Finished			
Morton	22643	Mandan	Raw			
Morton	22573	Mandan	Finished			
Ohio						
Hamilton	26555	Cincinnati Water Works	Finished			
Hamilton	26554	Cincinnati Water Works	Raw			
Scioto	26556	South Webster Water Supply	Raw			
Scioto	26557	South Webster Water Supply	Finished		6	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Ohio						
Montgomery	26559	Dayton, Dept. of Water Supply	Raw			
Montgomery	26560	Dayton, Dept. of Water Supply	Finished		6	
Miami	26562	Piqua Water Supply	Raw		11	
Miami	26561	Piqua Water Supply	Finished		8	
Muskingum	11034	South Zanesville; Maysville Reg. Water District	Raw			
Muskingum	11033	South Zanesville; Maysville Reg. Water District	Finished			15
Seneca	11046	Fostoria	Raw			
Seneca	26573	Fostoria	Finished			
Warren	26119	South Lebanon	Raw			
Warren	26120	South Lebanon	Finished		5	
Cuyahoga	26121	Bedford Water Co.	Raw		12 spike	
Cuyahoga	26122	Bedford Water Co.	Finished		6 spike	
Fulton	26593	Waseon	Finished		4	
Fulton	26594	Waseon	Raw		4	
Lucas	26595 #1	Toledo	Finished			
Lucas	26595 #2	Toledo	Finished			
Lucas	26596	Toledo	Raw			
Ashtabula	26597	Rock Creek; Lakeside Utility Corp.	Raw			
Ashtabula	26598	Rock Creek; Lakeside Utility Corp.	Finished			
Lorain	26599	Grafton	Raw			
Lorain	26600	Grafton	Finished			
Oklahoma						
Jackson	23054	Altus	Raw			
Jackson	23053	Altus	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Oregon						
Clackamas	22679	Gladstone	Finished			
Clackamas	22705	Gladstone	Raw			
Coos	22695	Powers	Raw			
Coos	22669	Powers	Finished			
Marion	22718	Salem; Lombard Water Co.	Raw			
Marion	22709	Salem	Raw			
Marion	22683	Salem	Finished			
Multnomah	22708	Portland	Raw			
Multnomah	22682	Portland	Finished		4	
Douglas	22702	Roseburg; Oregon Water Corp.	Raw			
Douglas	22676	Roseburg; Oregon Water Corp.	Finished			
Curry	22691	Brookings	Raw			
Curry	22664	Brookings	Finished			
Douglas	22694	Sutherlin	Raw			
Douglas	22668	Sutherlin	Finished			
Polk	22703	Dallas	Raw			
Polk	22677	Dallas	Finished			
Benton	22704	Corvallis	Raw			
Benton	22678	Corvallis	Finished			
Lane	22707	Eugene	Raw			
Lane	22681	Eugene	Finished			
Tillamook	22693	Tillamook; Cape Mears Co-op Water System	Raw			
Tillamook	22667	Tillamook; Cape Mears Co-op Water System	Finished			
Hood River	22731	Hood River	Raw			
Clatsop	22692	Astoria; Wickiup Water District	Raw			
Clatsop	22666	Astoria; Wickiup Water District	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Pennsylvania						
Harland	32961	Scotdale	Raw		4	23 spike
Harland	32962	Scotdale	Finished		18	31 spike
Armstrong	22966	Cadogan	Finished			
Armstrong	22965	Cadogan	Raw			
Lawrence	22968	Ellwood City; Western Penna. Water Co.	Finished			
Lawrence	22967	Ellwood City; Western Penna. Water Co.	Raw			
Erie	22970	Erie	Finished			
Erie	22969	Erie	Raw			
Harland	32961	Scotdale	Raw		8	23 spike†
Harland	32962	Scotdale	Finished		7	19 spike†
Delaware	22973	Chester	Raw		6	
Delaware	22974	Chester	Finished			
Chester	22977	Downington	Finished			
Chester	22978	Downington	Raw			
Northampton	22975	Easton	Raw			
Northampton	22976	Easton	Finished			
--	25131	Milesburg	Finished			
--	25132	Milesburg	Raw		4	
--	25130	Nicholson	Finished			
--	25133	Nicholson	Raw			
--	32932	Charleroi	Raw		4	
--	32933	Charleroi	Finished			
--	32935	Pittsburgh	Raw			
--	32934	Pittsburgh	Finished		4	
--	32936	Moontownship	Finished		6	
--	32937	Moontownship	Raw		8	14
Allegheny	22971	Braddock Borough	Raw			
Allegheny	22972	Braddock Borough	Finished		7	20

† 32961: DDD, 2; DDE, 8; 32962: DDD, 4; DDE, 12; spike.

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Rhode Island						
Providence	25059	Scituate; Providence Water Board	Raw			
Providence	25060	Scituate; Providence Water Board	Finished			
Kent	25061	Warwick; Kent Co. Water Authority	Raw			
Kent	25062	Warwick; Kent Co. Water Authority	Finished			
South Carolina						
Charleston	25233	Charleston Commissioners of Public Works	Raw			
Charleston	25234	Charleston Commissioners of Public Works	Finished			
Saluda	25237	Saluda Water Dept.	Raw			
Saluda	25238*	Saluda Water Dept.	Finished			
Lancaster	25239	Lancaster; Lancaster Co. Water & Sewer District	Raw			
Lancaster	25240	Lancaster; Lancaster Co. Water & Sewer District	Finished			
Anderson	25241	Williamston; Town Water Dept.	Raw		4	
Anderson	25242	Williamston; Town Water Dept.	Finished			
York	25236	Catawba; Bowaters Caroline Corp.	Finished			
York	25235	Catawba; Bowaters Carolina Corp.	Raw			
South Dakota						
Meade	22636	Faith, Water Department	Raw			
Meade	22566*	Faith, Water Department	Finished			
Minnehaha	22621	Sioux Falls City Water Department	Raw			
Minnehaha	22579	Sioux Falls City Water Department	Finished			
Brookings	22623	Brookings City Water Department	Raw			
Brookings	22561	Brookings City Water Department	Finished			
Beadle	22625	Huron City Water Department	Raw			
Beadle	22560	Huron City Water Department	Finished			
Yankton	22639	Yankton, City Water Dept.	Raw			
Yankton	22564	Yankton, City Water Dept.	Finished			
Jones	22572	Murdo Municipal Supply	Finished			
Jones	22644	Murdo Municipal Supply	Raw			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Tennessee						
Anderson	25249	Clinton	Raw			
Anderson	25250	Clinton	Finished			
Lake	25253	Ridgely	Raw			
Lake	25254	Ridgely	Finished			
Stewart	25251	Dover	Raw			
Stewart	25252	Dover	Finished			
Texas						
Cameron	23028	Brownsville Public Utility Board	Raw			
Cameron	23027*	Brownsville Public Utility Board	Finished			
Starr	23025	Rio Grande City; Starr Co. WCID #2	Finished			
Starr	23026	Rio Grande City; Starr Co. WCID #2	Raw			
Hidalgo	23023	Mission	Finished			
Hidalgo	23024	Mission	Raw			
Henderson	23043	Tool, Community Water Co.	Finished			
Henderson	23044	Tool, Community Water Co.	Raw			
Henderson	23045	Mabank; Enchanted Oaks M.U.D.	Finished		5	
Henderson	23046	Mabank; Enchanted Oaks M.U.D.	Raw			
Henderson	23047	Eastwood Island; Cedar Creek Lake	Finished			
Henderson	23048	Eastwood Island; Cedar Creek Lake	Raw			
Crosby	23052	Spur; White River M.U.D.	Raw			
Crosby	23051	Spur; White River M.U.D.	Finished			
Tom Green	23049	San Angelo	Raw			
Tom Green	23050	San Angelo	Finished			
Nueces	23058	Corpus Christi	Raw			
Nueces	23057	Corpus Christi	Finished			
Jim Weus	23056	Premont	Raw			
Jim Weus	23055	Premont	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Texas						
Lamar	23040	Paris	Raw			
Lamar	23039	Paris	Finished			
Bowie	23042	Texarkana	Raw			
Bowie	23041	Texarkana	Finished			
Guadalupe	23060	McQueeney	Raw			
Guadalupe	23059	McQueeney	Finished			
Bell	23064	Nolanville; Bell Co. WCID #1	Raw			
Bell	23062	Nolanville; Bell Co. WCID #1	Finished			
Burnett	23065	Buena Vista Subdivision; Buchanan Dam	Finished			
Burnett	23066	Buena Vista Subdivision; Buchanan Dam	Raw			
San Augustine	23037	San Augustine	Raw			
San Augustine	23038	San Augustine	Finished			
Galveston	23067	Galveston	Raw			
Galveston	23068	Galveston	Finished			
Tarrant	23070	Fort Worth	Finished			
Tarrant	23069	Fort Worth	Raw			
Calhoun	23072	Port Lavaca; Guadalupe-Blanco River Authority	Raw			
Calhoun	23073	Port Lavaca; Guadalupe-Blanco River Authority	Finished			
Utah						
--	12643	Orem	Raw			
--	12521	Orem	Finished			
--	12646	Provo	Raw			
--	12524	Provo	Finished			
Weber	12645	Ogden	Raw			
Weber	12523	Ogden	Finished			32
Salt Lake	12647	Salt Lake City	Raw			
Salt Lake	12525	Salt Lake City	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Utah						
Carbon	12644	Price	Raw		5	28
Carbon	12522	Price	Finished			
Emery	12642	Green River	Raw			
Emery	12520	Green River	Finished			
Vermont						
Grand Isle	25005	Grand Isle	Raw			
Grand Isle	25006	Grand Isle	Finished			
Bennington	25007	Readsboro	Raw			
Bennington	25008	Readsboro	Finished			
Chittenden	25009	Burlington	Raw			
Chittenden	25010	Burlington	Finished			
Chittenden	25011	So. Burlington; Champlain Water District	Raw			
Chittenden	25012	So. Burlington; Champlain Water District	Finished			
Chittenden	25014	Westford; Rolling Acres Mobile Home Park	Raw			
Chittenden	25016	Westford; Rolling Acres Mobile Home Park	Finished			
Orleans	25017	Coventry; Coventry Fire District #1	Raw			
Orleans	25018	Coventry; Coventry Fire District #1	Finished			
Virginia						
--	22924	Lynchburg, Abert Water Treatment Plant	Finished			
--	22923	Lynchburg, Abert Water Treatment Plant	Raw			
Brunswick	22926	Lawrenceville, Water Treatment Plant	Finished			
Brunswick	22925	Lawrenceville, Water Treatment Plant	Raw			
Pittsylvania	22921	Danville	Raw		9	
Pittsylvania	22922	Danville	Finished		8	
Pittsylvania	22918	Gretna	Raw		8	
Pittsylvania	22919	Gretna	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Virginia						
Prince William	22917	Quantico Marine Base; Camp Barrett Water Treatment Plant	Finished			
Prince William	22915	Quantico Marine Base; Camp Barrett Water Treatment Plant	Raw			
--	22916	Culpepper	Finished			
--	22909	Culpepper	Raw			
--	22914	Fredericksburg	Raw		5	14
--	22913	Fredericksburg	Finished			
Alleghany	22928	Clearwater Park Subdivision	Finished			
Alleghany	22929	Clearwater Park Subdivision	Raw			
--	22931	Charlottesville; So. Rivanne Water Treatment Plant	Raw			
--	22930	Charlottesville; So. Rivanne Water Treatment Plant	Finished			
Washington						
Snohomish	22711	Everett	Raw			
Snohomish	22685	Everett	Finished			
Cowlitz	22733	Kelso	Raw			
Cowlitz	22734	Kelso	Finished			
Whatcom	22715	Bellingham	Raw			
Whatcom	22716	Bellingham	Finished		5	
Whitman	22722	Pullman; Washington State University	Raw			
Whitman	22721	Pullman; Washington State University	Finished			
Pierce	22696	Steilacoom; Eden Creek Filtration Plant	Raw			
Pierce	22670	Steilacoom; Eden Creek Filtration Plant	Finished			
King	22684	Seattle	Raw			
King	22710	Seattle	Finished		4	

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Washington						
Pierce	22713	Tacoma	Raw			
Pierce	22688	Tacoma	Finished			
Franklin	22699	Pasco	Raw			
Franklin	22673	Pasco	Finished			
Pacific	22697	Raymond	Raw			
Pacific	22671	Raymond	Finished			
Grays Harbor	22700	Aberdeen	Raw			
Grays Harbor	22674	Aberdeen	Finished			
Chelan	22701	Wenatchee	Raw			
Chelan	22675	Wenatchee	Finished			
Grant	22720	Soap Lake; Lakeview Park Water Assn.	Raw			
Grant	22719	Soap Lake; Lakeview Park Water Assn.	Finished			
Pacific	22672	Ilwaco	Finished			
Pacific	22698	Ilwaco	Raw			
Spokane	22726	Spokane	Raw			
Spokane	22725	Spokane	Finished			
Yakima	22714	Yakima	Raw			
Yakima	22689	Yakima	Finished			
West Virginia						
Kanawha	22949	Charleston; West Virginia Water Co.	Raw			
Kanawha	22956	Charleston; West Virginia Water Co.	Finished			
Cabell	22950	Milton; Grant Utility Co. (Malcolm Spring Heights)	Raw			
Cabell	22955	Milton; Grant Utility Co. (Malcolm Spring Heights)	Finished			
Braxton	22952	Sutton; Flatwoods-Canoe Run PSD	Raw			
Braxton	22960	Sutton; Flatwoods-Canoe Run PSD	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Continued)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
West Virginia						
Lewis	22961	Weston; Jackson Mills State 4-H Camp	Raw			
Lewis	22953	Weston; Jackson Mills State 4-H Camp	Finished			
Harrison	22962	West Milford	Raw			
Harrison	22951	West Milford	Finished			
Ohio	22959	Wheeling	Raw		5	
Ohio	22954	Wheeling	Finished			
Morgan	22957	Berkeley Springs	Raw			
Morgan	22989	Berkeley Springs	Finished			
Wisconsin						
Winnebago	26415	Oshkosh	Raw			
Winnebago	26416	Oshkosh	Finished			
Brown	26422	Green Bay	Raw			
Brown	26421	Green Bay	Finished			
Menominee	26423	Neopit, Neopit-Menominee Water Utility	Finished			
Menominee	26424	Neopit, Neopit-Menominee Water Utility	Raw			
Langlade	26432	Antigo	Raw			
Langlade	26431	Antigo	Finished			
Wyoming						
Washakie	22582	Worland. City Water Dept.	Finished			
Washakie	22642	Worland, City Water Dept.	Raw			
Bighorn	22583	Basin	Finished			
Bighorn	22654	Basin	Raw			
Hot Springs	22580	Thermopolis	Finished			
Hot Springs	22655	Thermopolis	Raw			
Washington, D.C.						
--	22964	Washington; Washington Aquaduct Division	Raw			
--	22963	Washington; Washington Aquaduct Division	Finished			

PESTICIDE RESIDUES FOUND IN WATER (Concluded)

State/County	Sample No.	Name of Water Supply	Kind of Water	Aldrin (ppt)	Dieldrin (ppt)	DDT (ppt)
Puerto Rico						
--	25160	Coamo; P.R.A.S.A.-Coamo Plant	Raw			
--	25161	Coamo; P.R.A.S.A.-Coamo Plant	Finished			
--	25162	Guayanilla; P.R.A.S.A.-Guayanilla	Raw			
--	25163	Guayanilla; P.R.A.S.A.-Guayanilla	Finished			
--	25164	Mayaguez; P.R.A.S.A.-Mayaguez	Raw			
--	25165	Mayaguez; P.R.A.S.A.-Mayaguez	Finished			
--	25170	Angeles; P.R.A.S.A.-Angeles	Raw			
--	25171	Angeles; P.R.A.S.A.-Angeles	Finished			
--	25172	Mameyes	Raw			
--	25173	Mameyes	Finished			
--	25166	Aguadilla; P.R.A.S.A.-Aguadilla	Raw			
--	25167	Aguadilla; P.R.A.S.A.-Aguadilla	Finished			
--	25169	Utuado; P.R.A.S.A.-Utuado	Raw			
--	25168	Utuado; P.R.A.S.A.-Utuado	Finished			

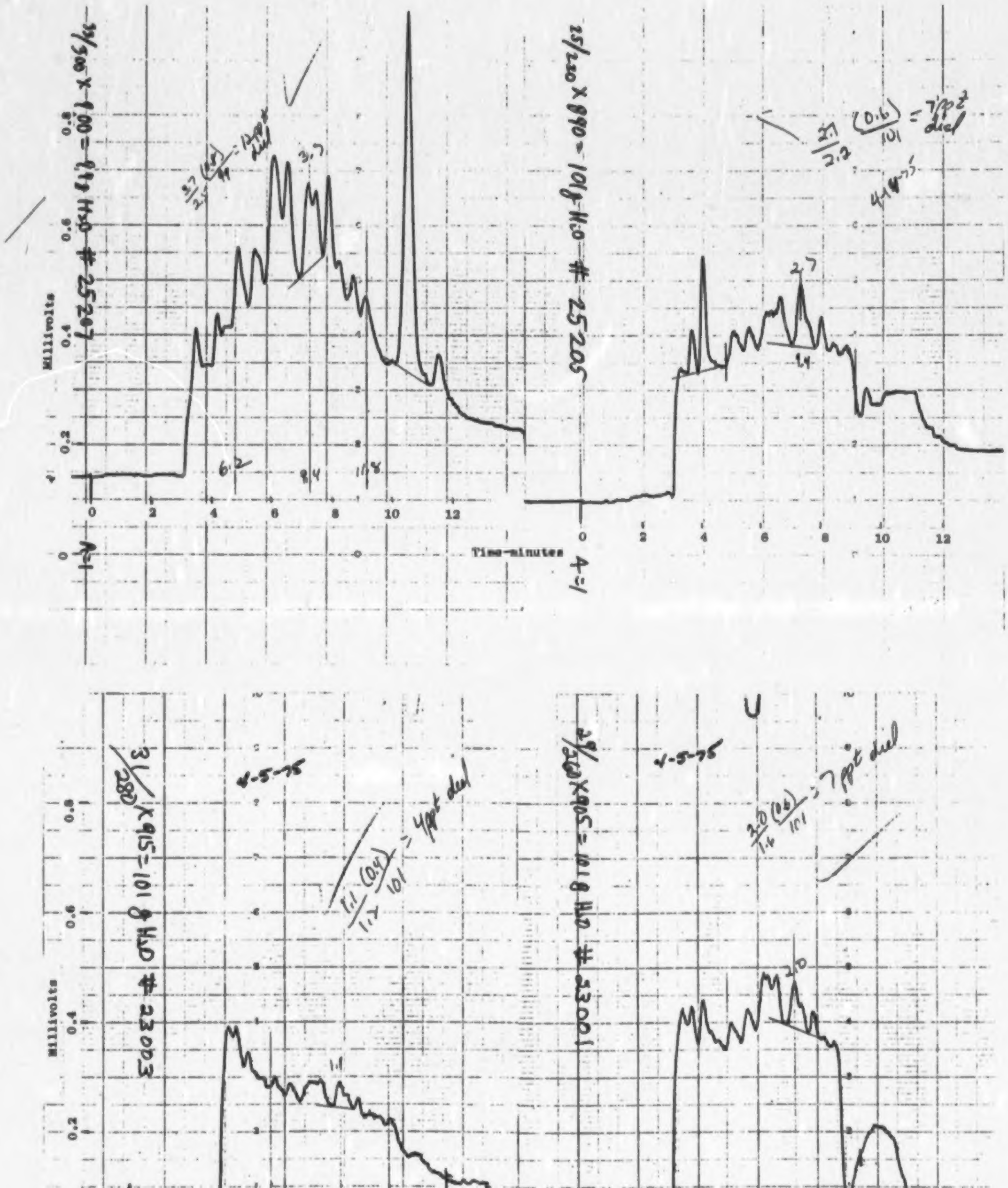


Figure 61 Sample Nos. 25207, 25205, 23003, 23001

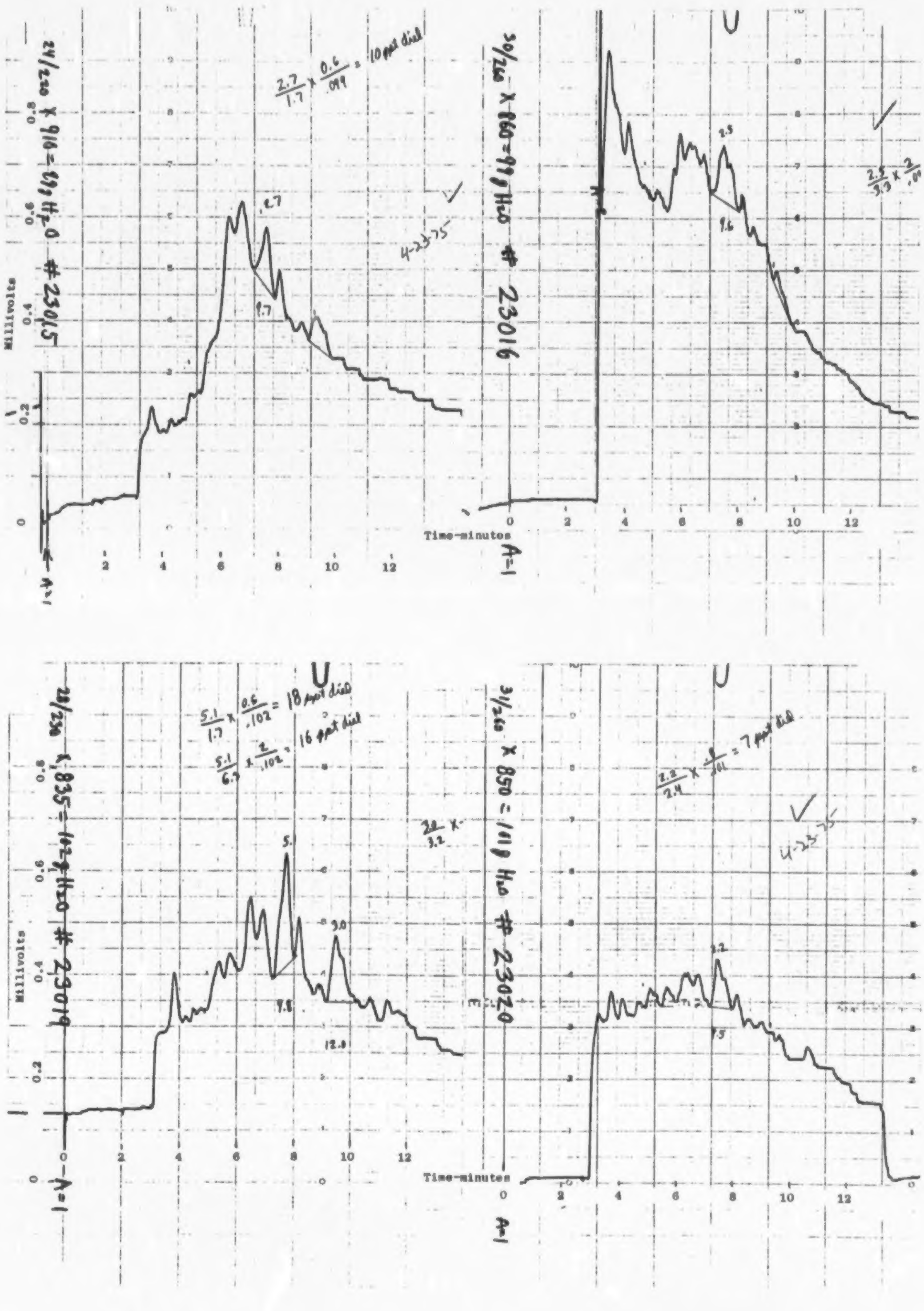


Figure 62 Sample Nos. 23015, 23016, 23019, 23020

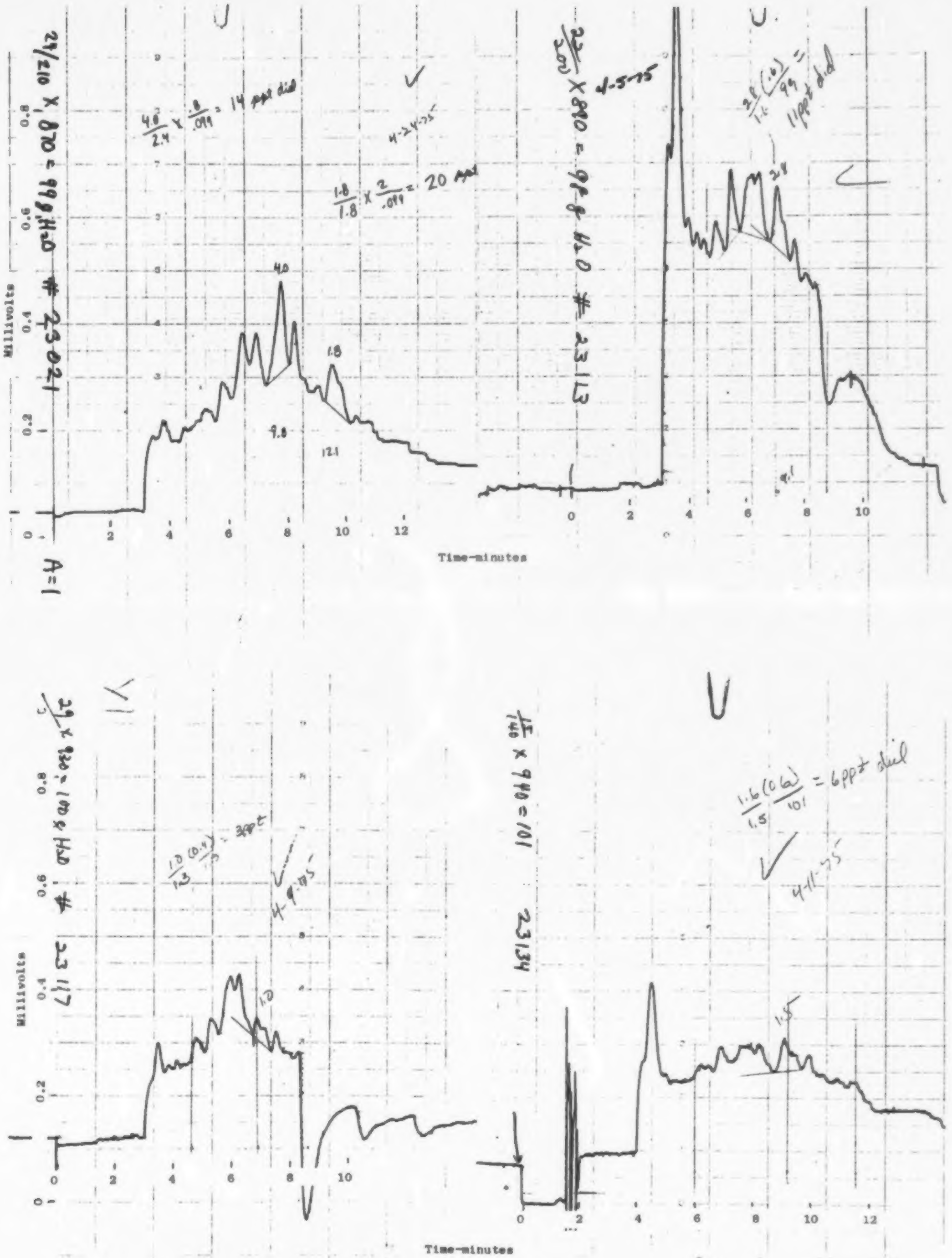


Figure 63 Sample Nos. 23021, 23113, 23117, 23114

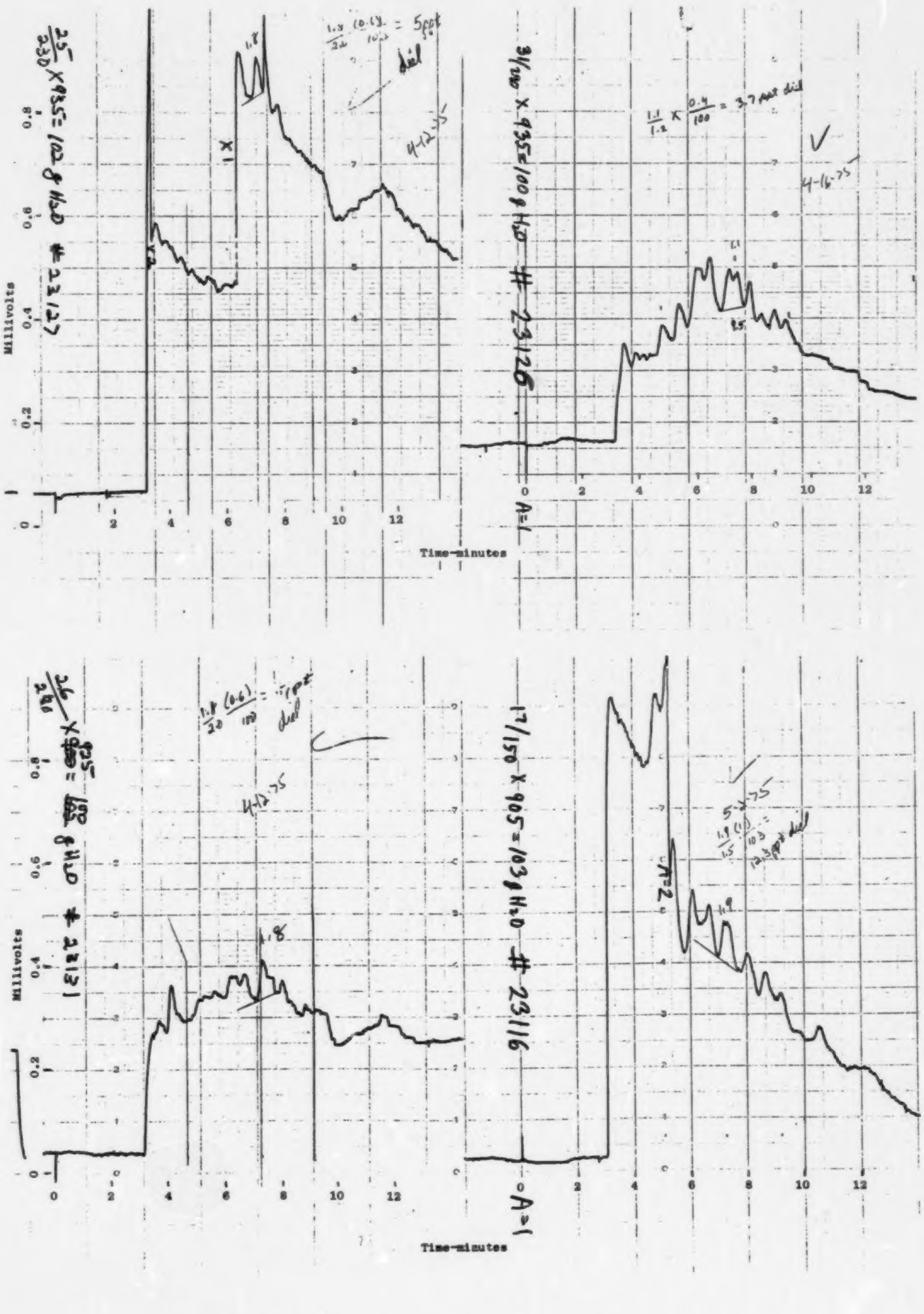


Figure 64 Sample Nos. 23127, 23126, 23131, 23116

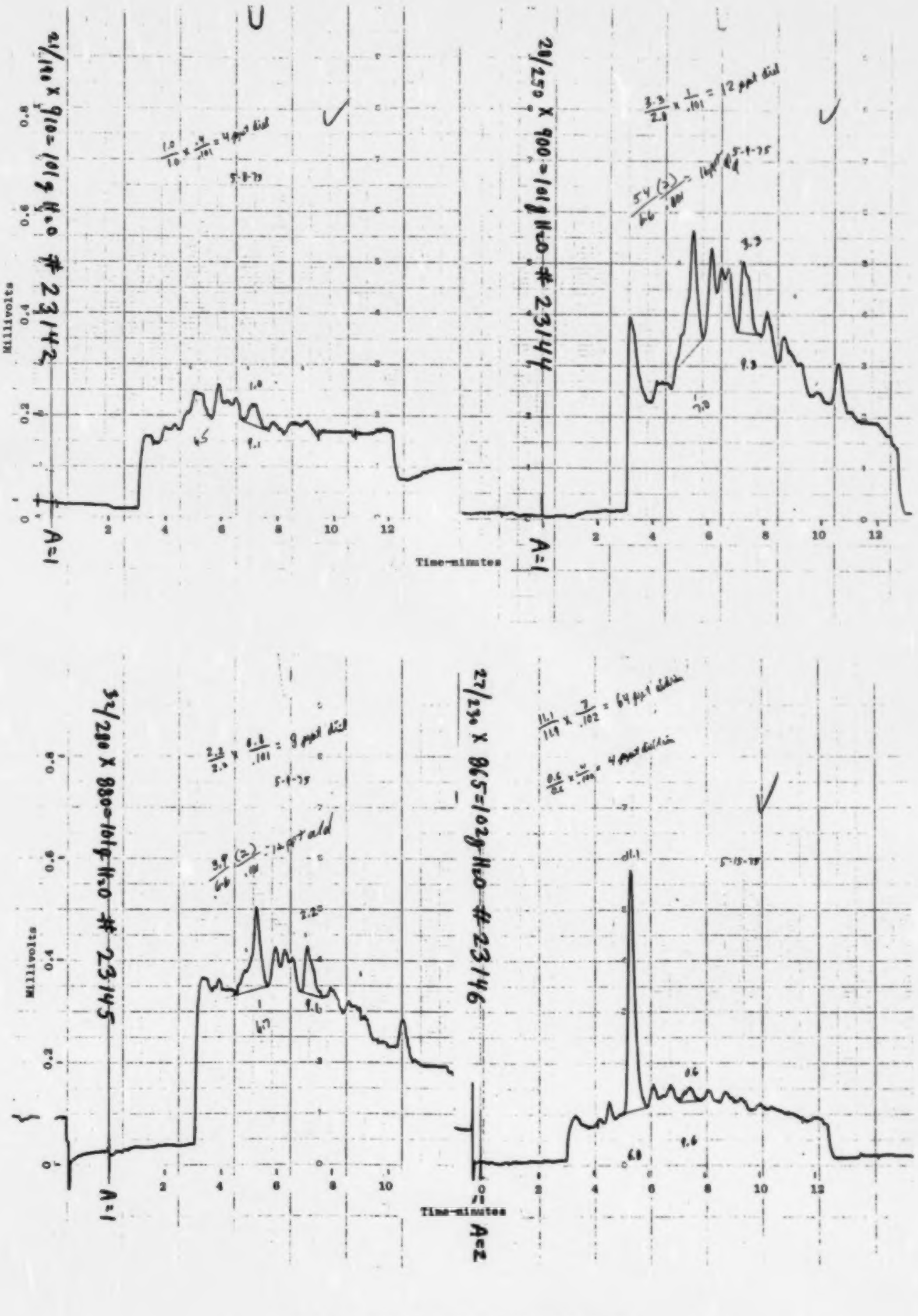


Figure 65 Sample Nos. 23142, 23144, 23145, 23146

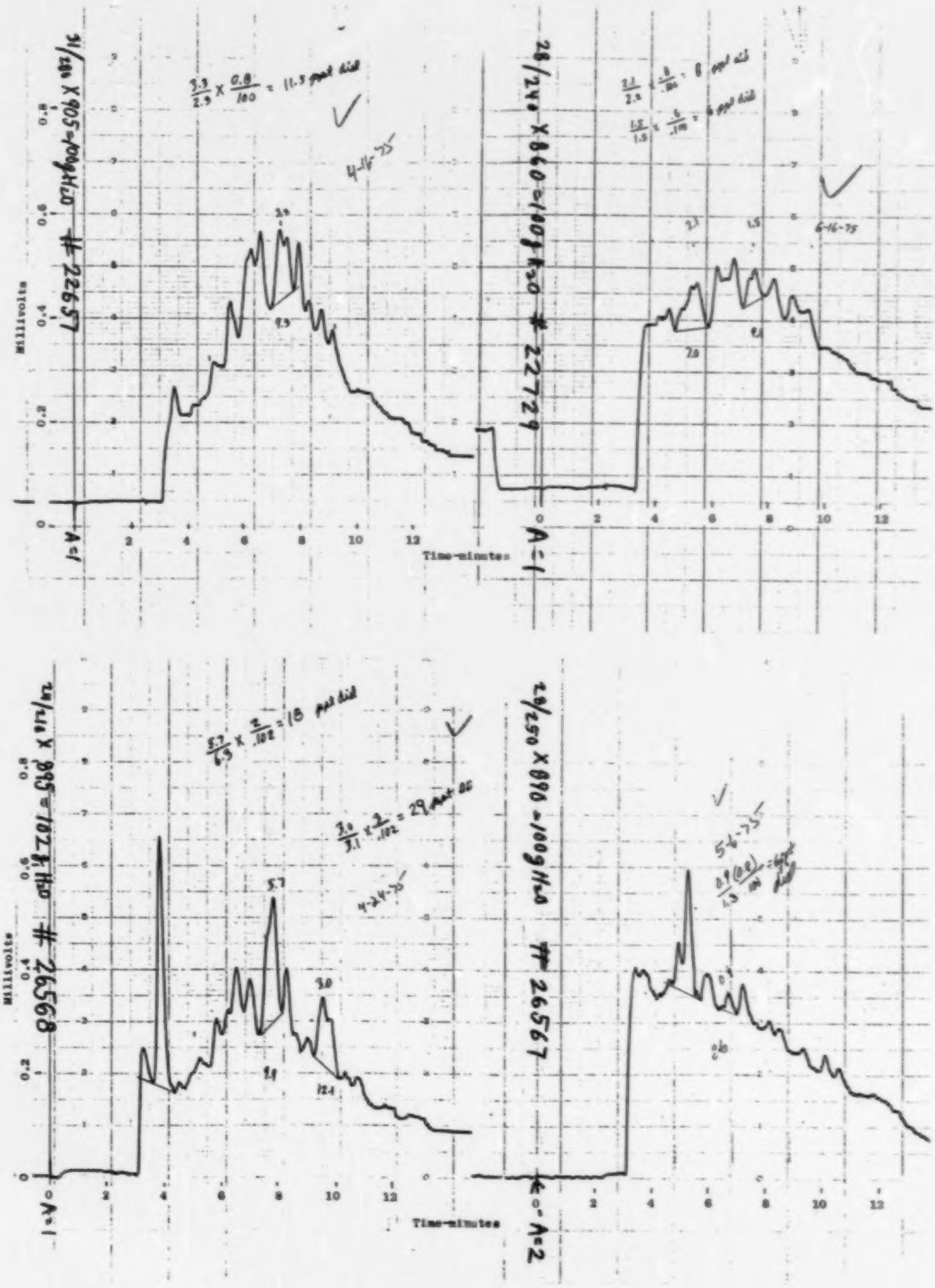


Figure 68 Sample Nos. 22657, 22729, 26568, 26567

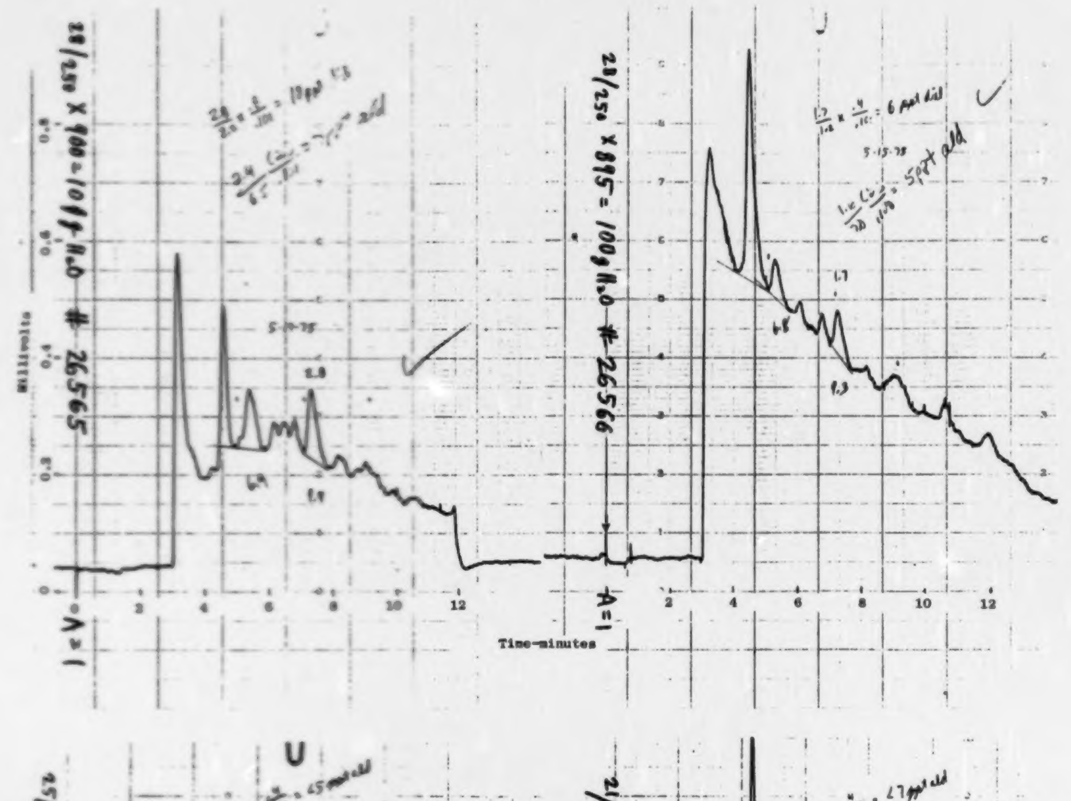


Figure 87 Sample Nos. 26565, 26566, 26575, 26574

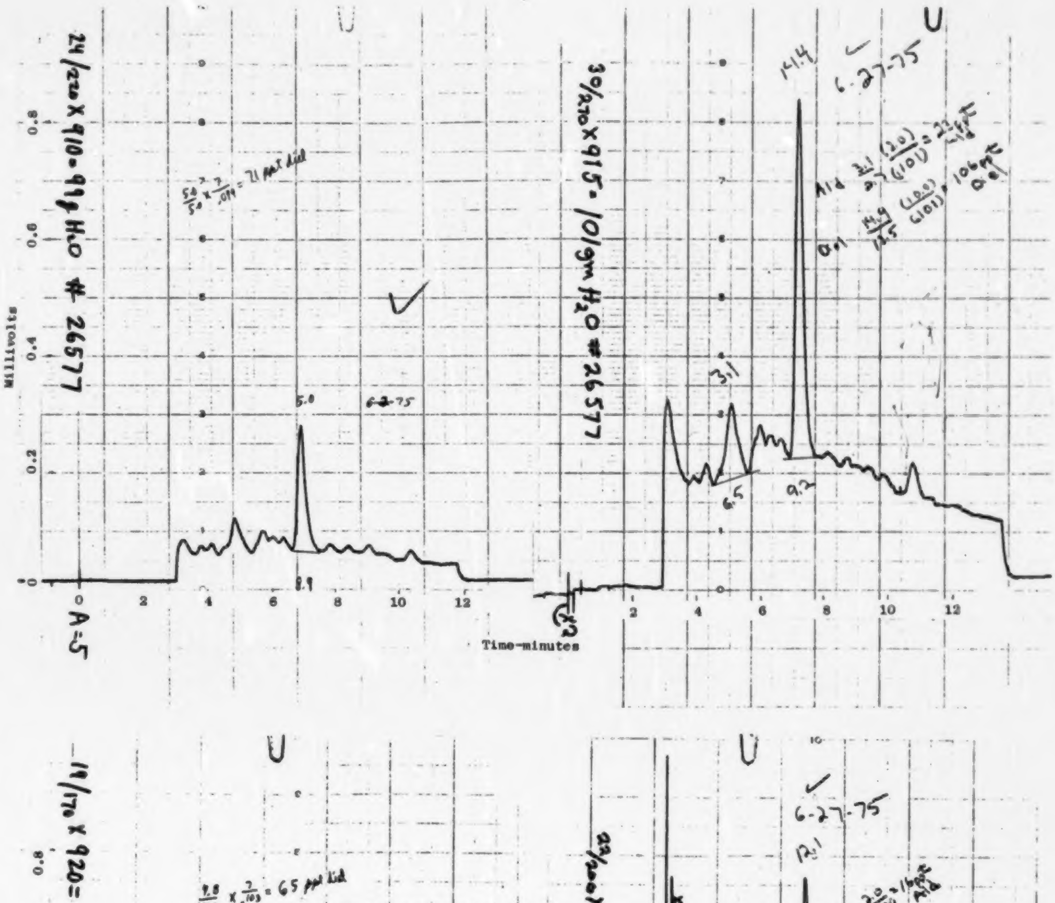


Figure 68 Sample Nos. 26577, 26576

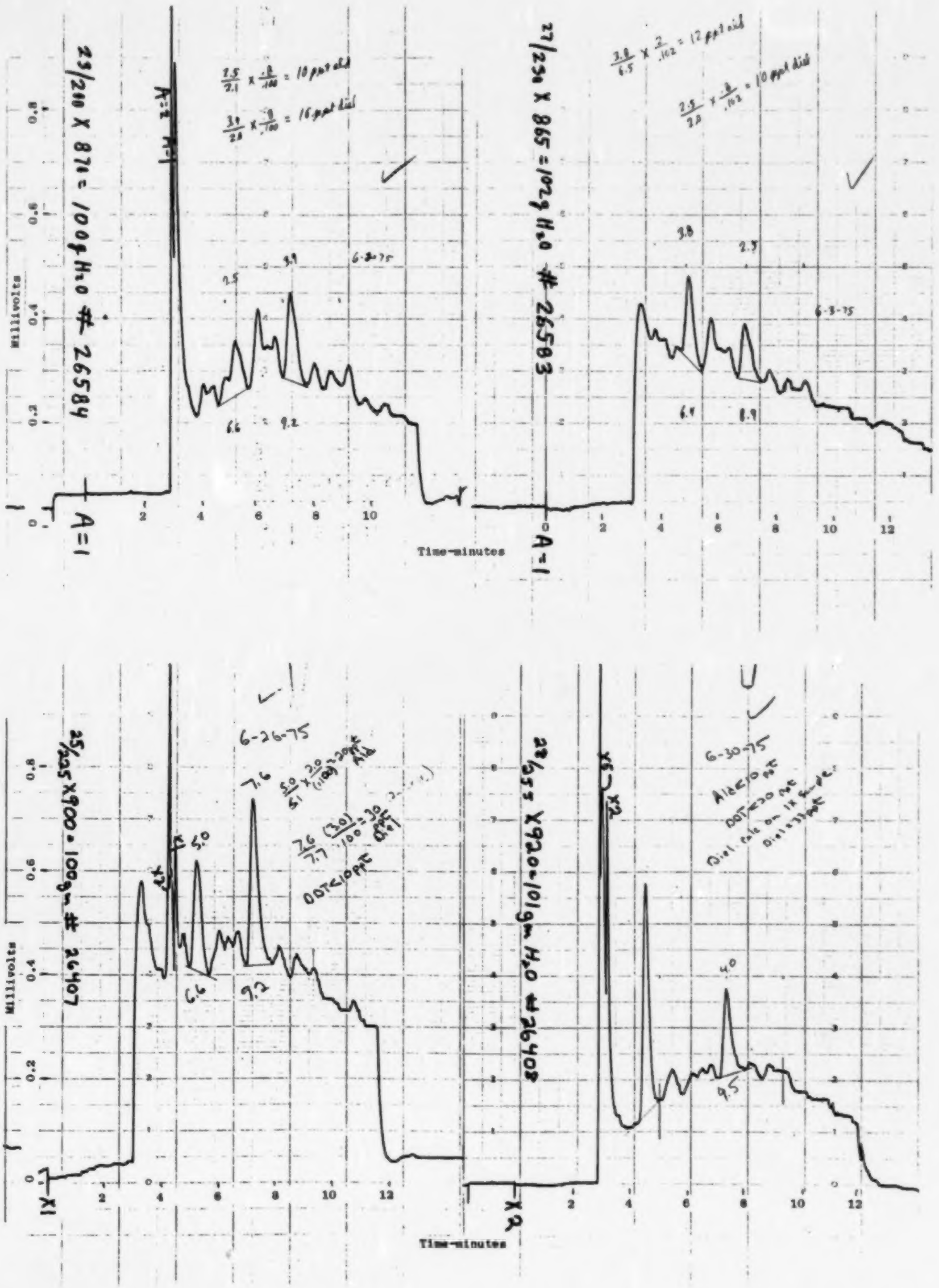


Figure 69 Sample Nos. 26584, 26583, 26407, 26408

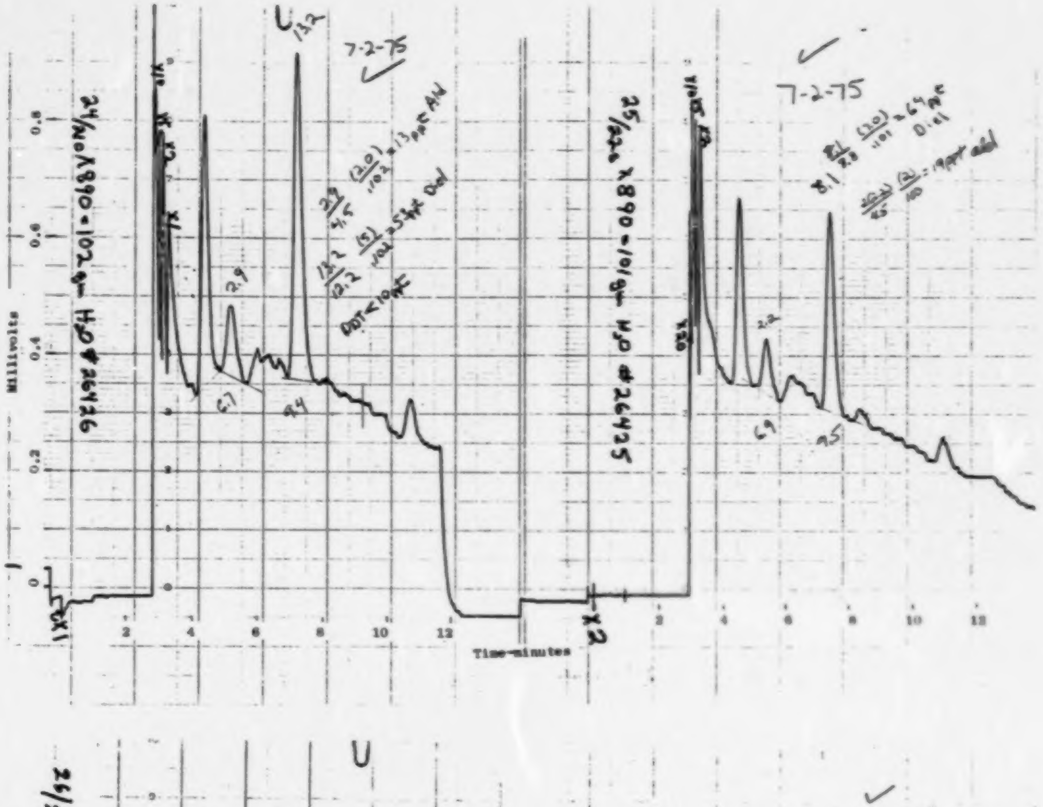


Figure 70 Sample Nos. 26426, 26425, 11042, 22503

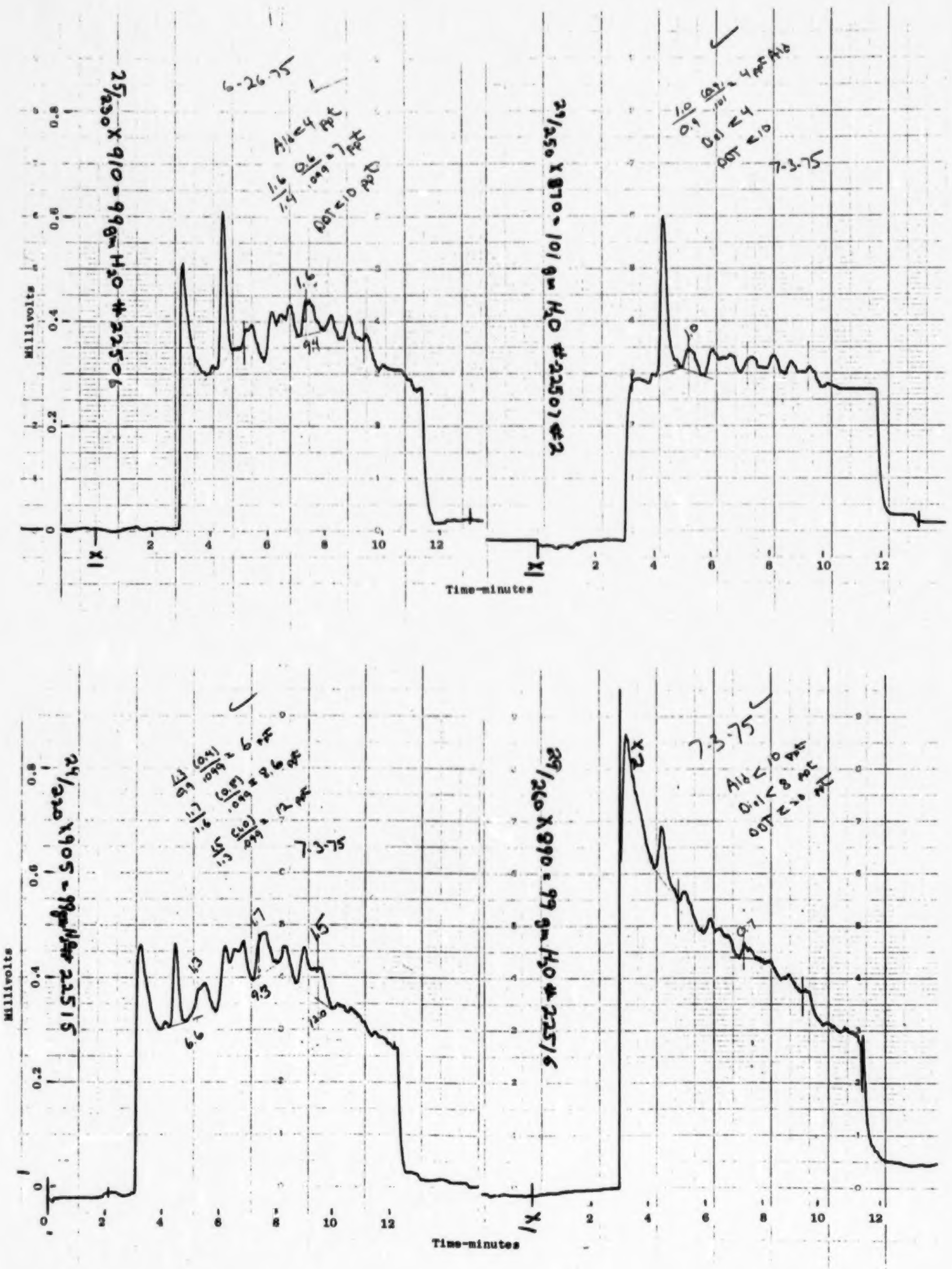


Figure 71 Sample Nos. 22506, 22507 (#2), 22515, 22516

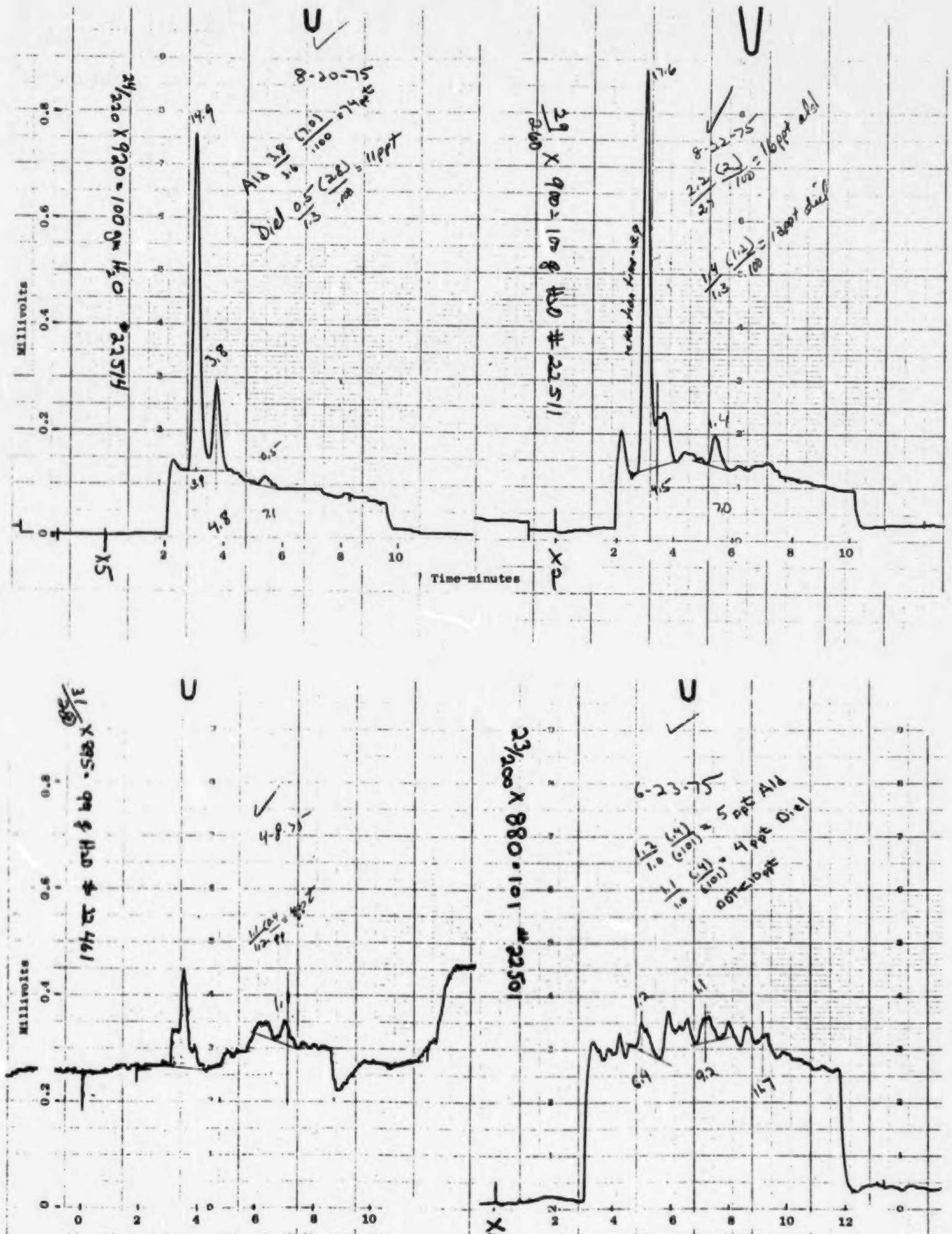


Figure 72 Sample Nos. 22514, 22511, 26401, 22501

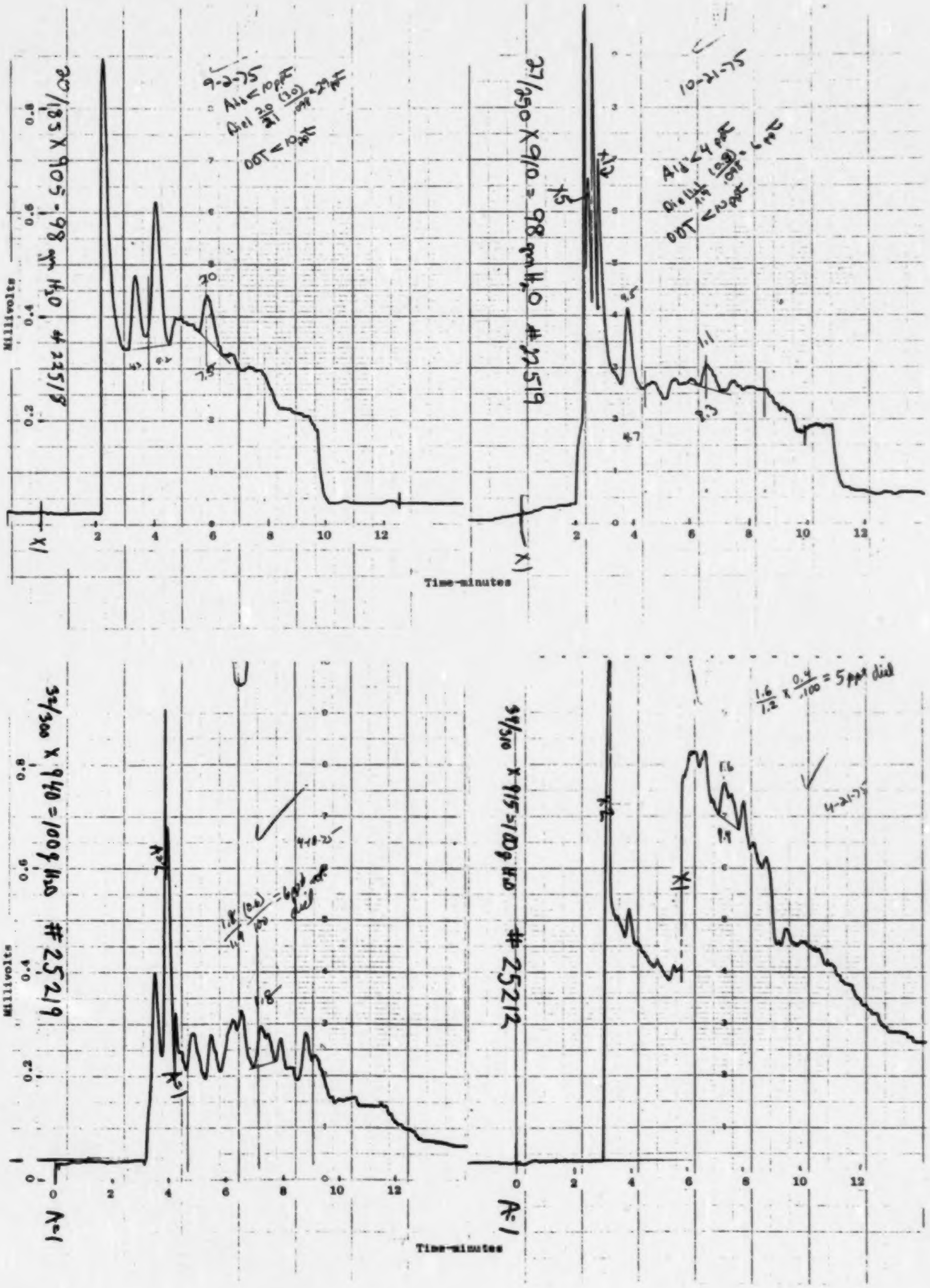
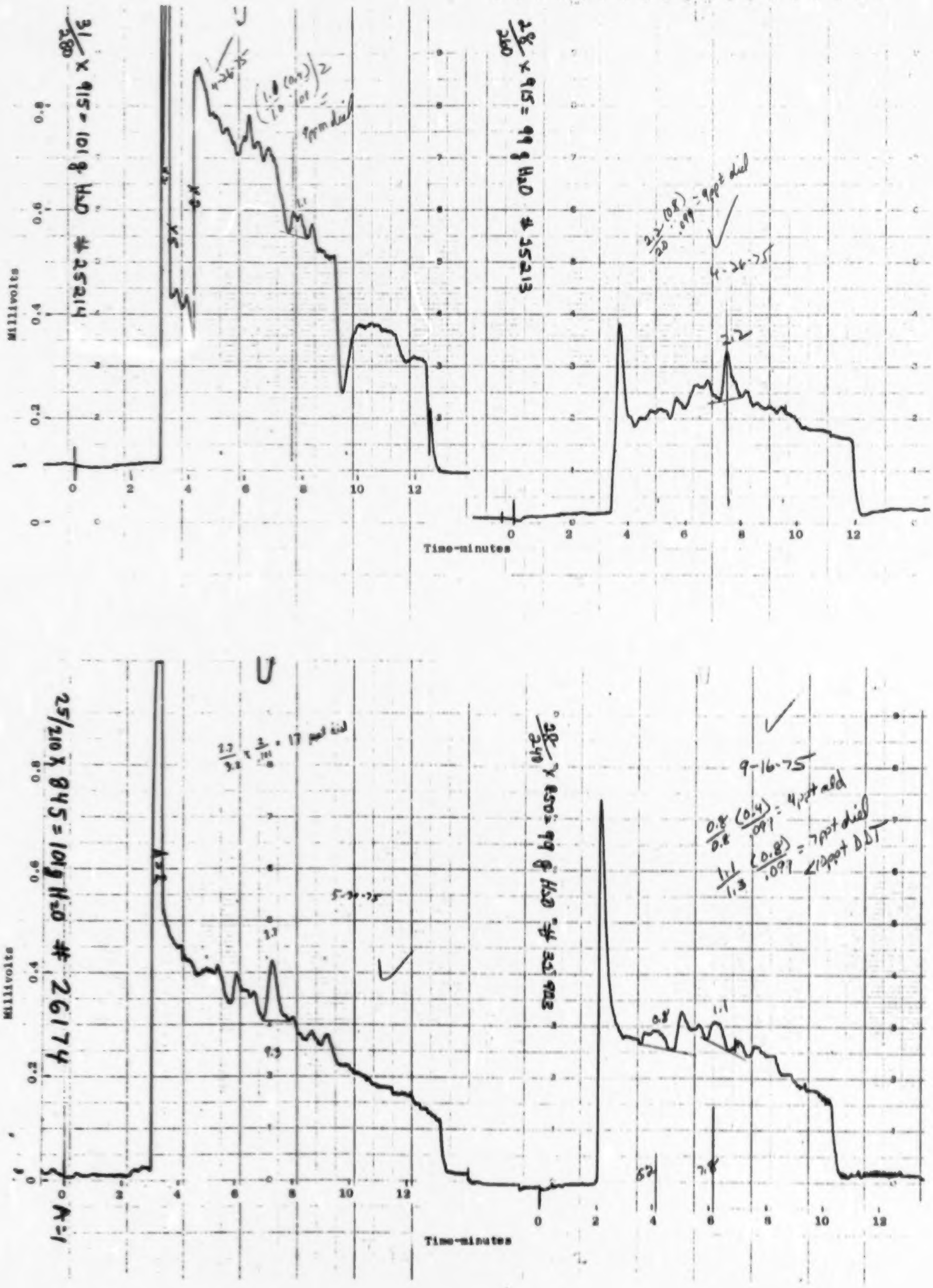


Figure 73 Sample Nos. 22518, 22519, 25219, 25212



31/280 X 915 = 101 g H2O # 25214

4-26-75

$\left(\frac{1.1}{1.0}\,\frac{(0.4)}{.101}\right)2$ = 9 ppm diel

28/240 X 915 = 99 g H2O # 35213

$\frac{2.2}{20}\,\frac{(0.8)}{.099}$ = 9 ppt diel

4-26-75

25/210 X 845 = 101 g H2O # 26174

$\frac{2.7}{3.2} \times \frac{3}{.101}$ = 17 ppt diel

5-30-75

28/240 X 850 = 99 g H2O # 32903

9-16-75

$\frac{0.8}{0.8}\,\frac{(0.4)}{.099}$ = 4 ppt ald

$\frac{1.1}{1.3}\,\frac{(0.8)}{.099}$ = 7 ppt diel

<10 ppt DDT

Figure 74 Sample Nos. 25214, 25213, 26174, 32903

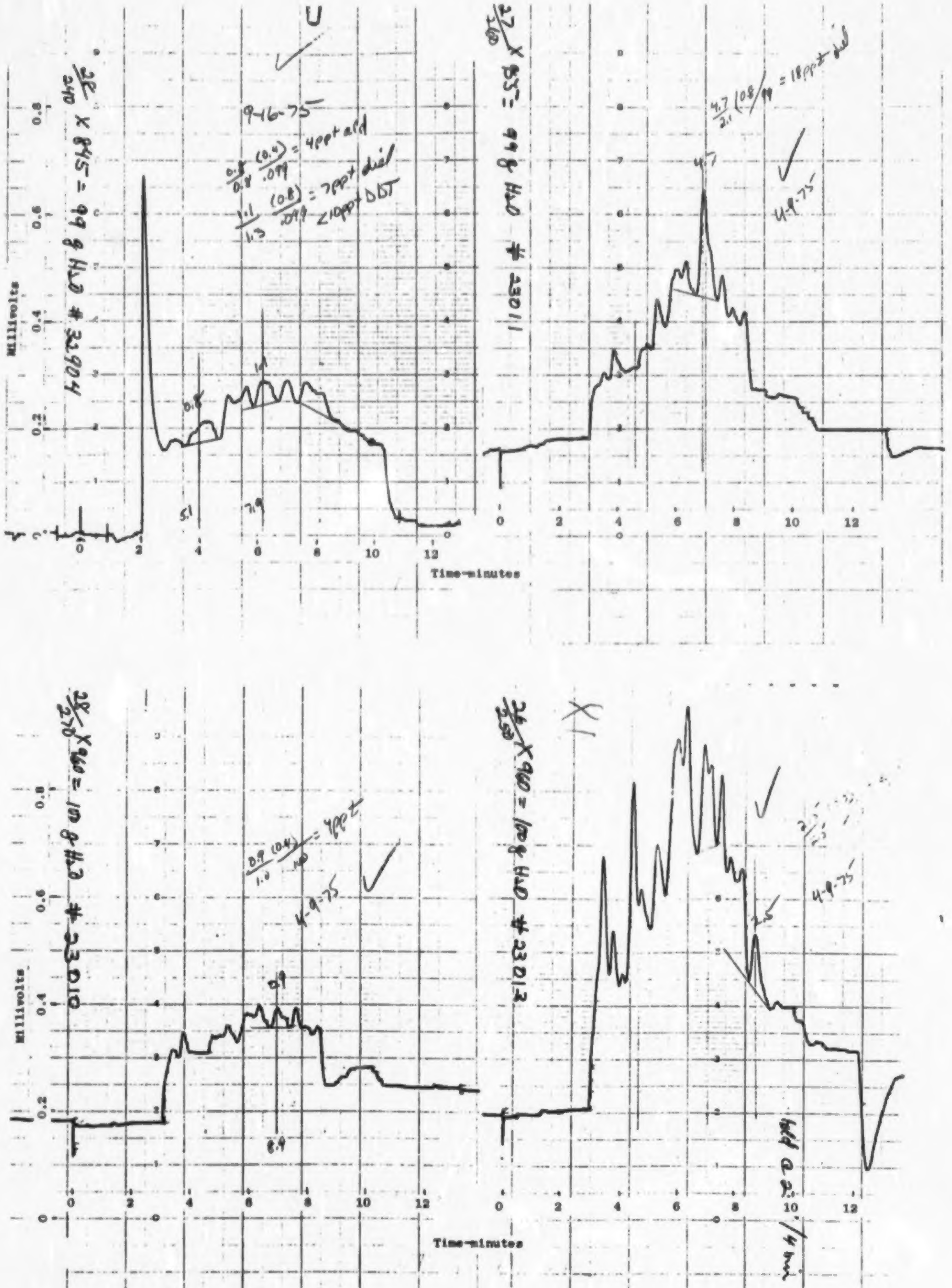


Figure 75 Sample Nos. 32904, 23011, 23010, 23013

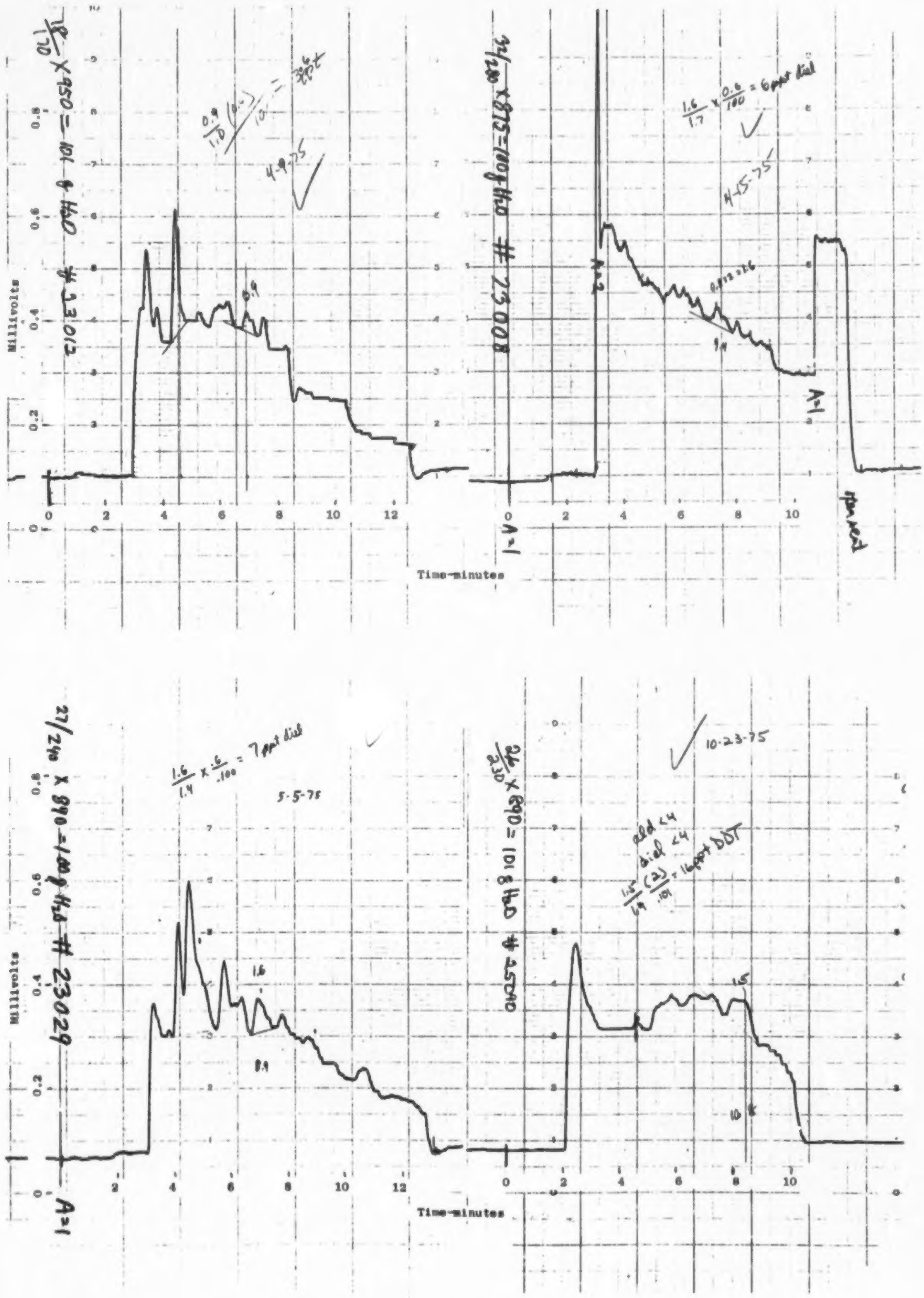


Figure 76 Sample Nos. 23012, 23008, 23029, 25040

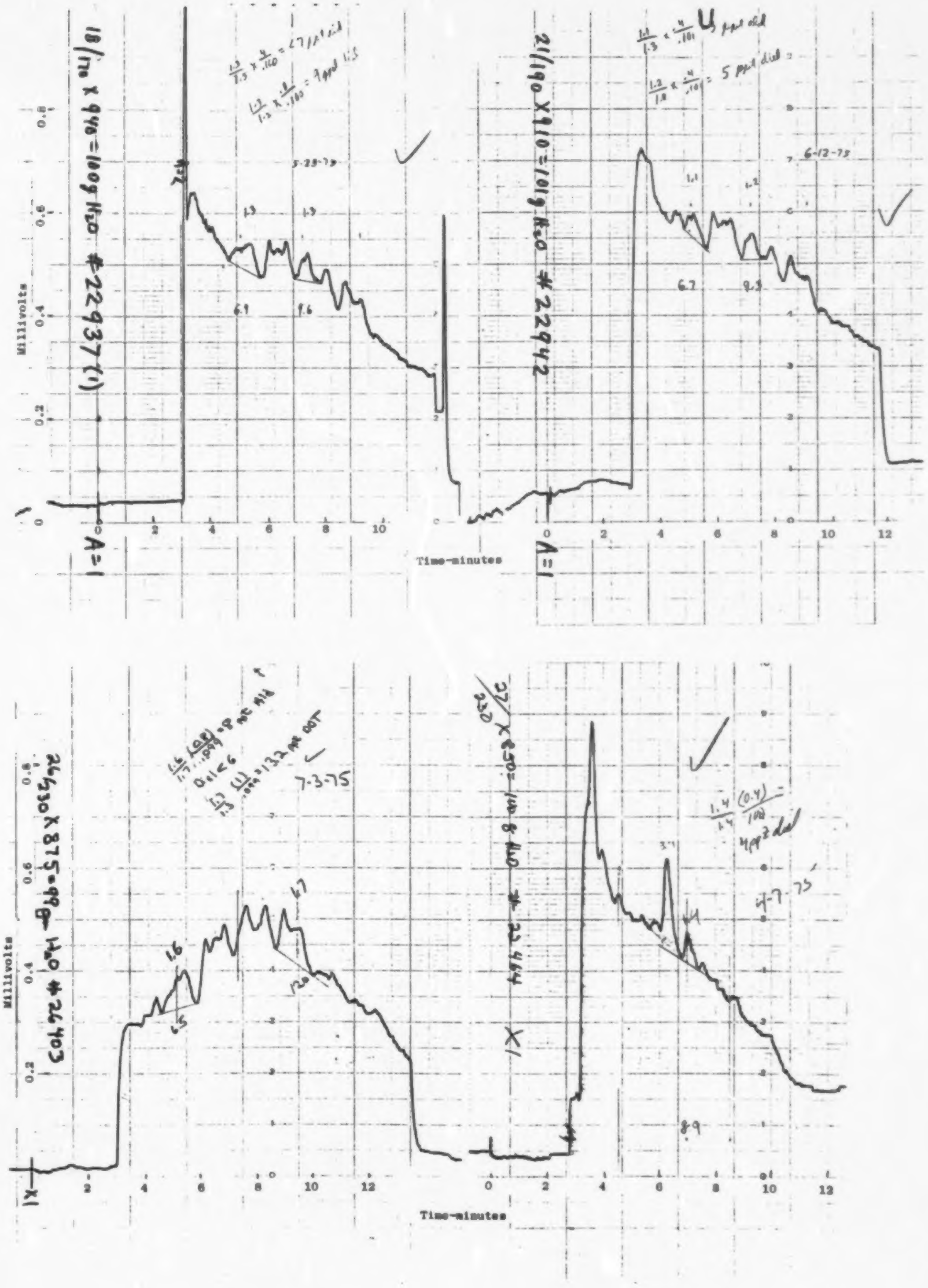


Figure 77 Sample Nos. 22937, 22942, 26403, 22464

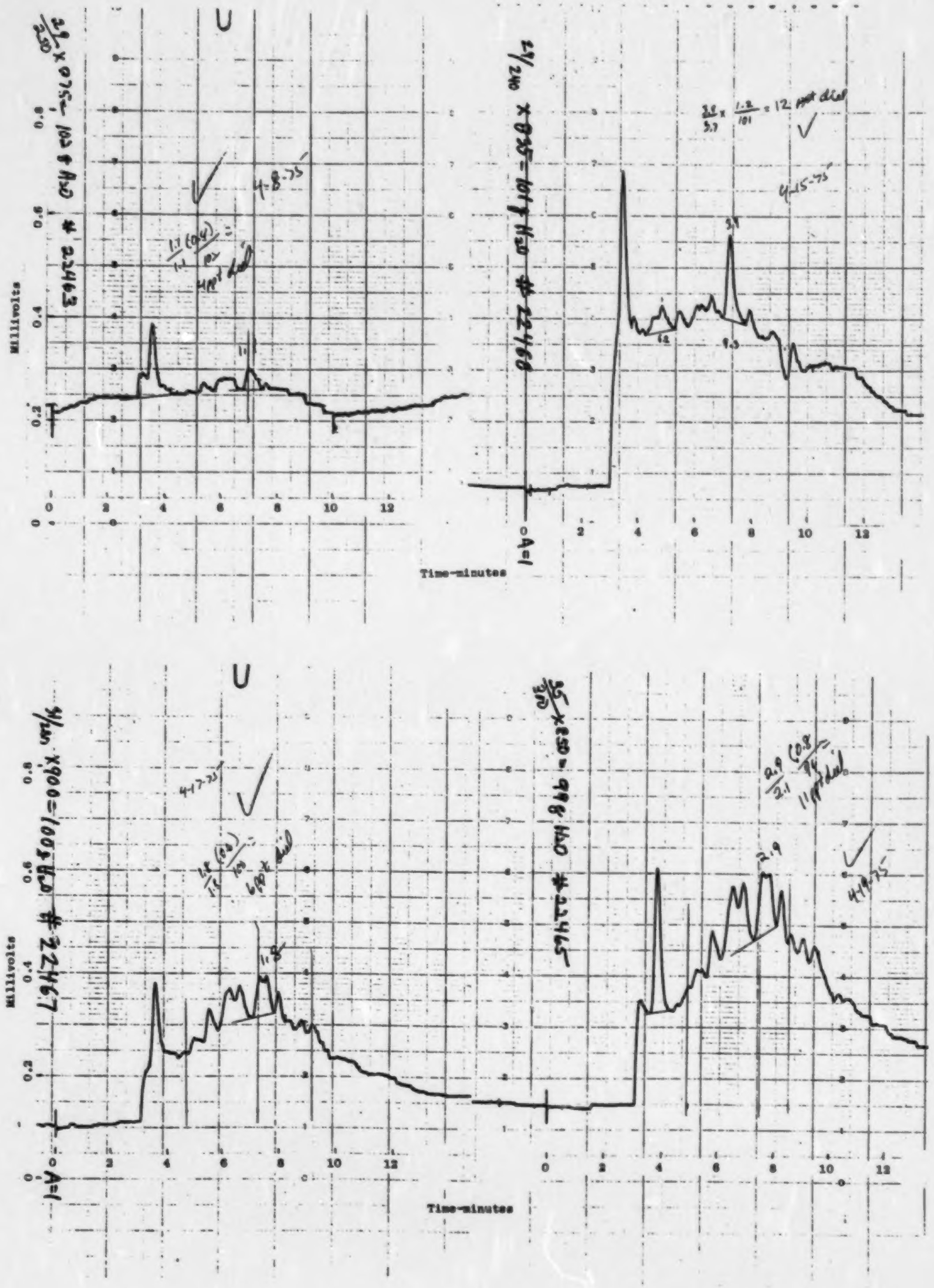


Figure 78 Sample Nos. 22463, 22468, 22467, 22465

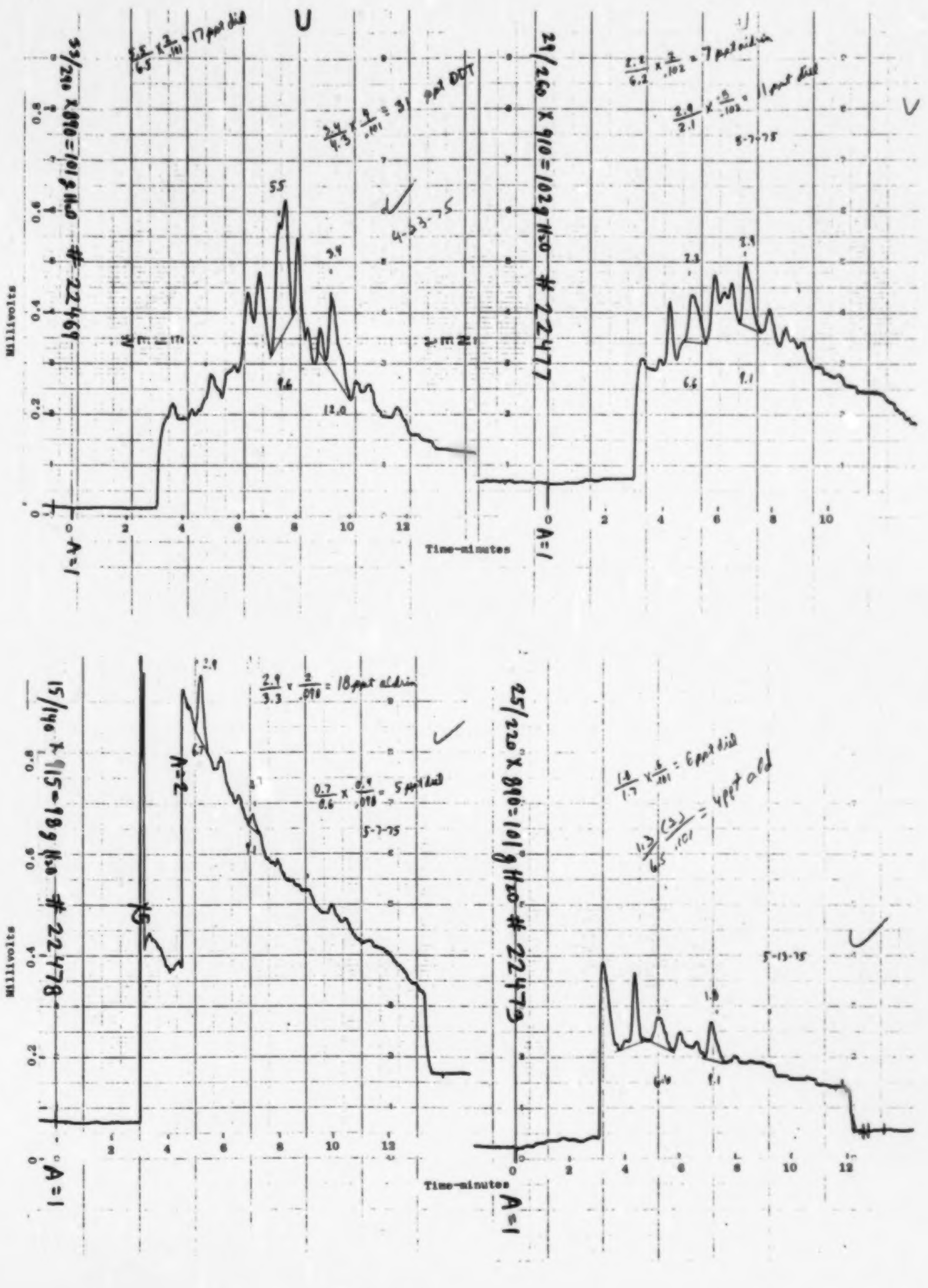


Figure 79 Sample Nos. 22469, 22477, 22478, 22473

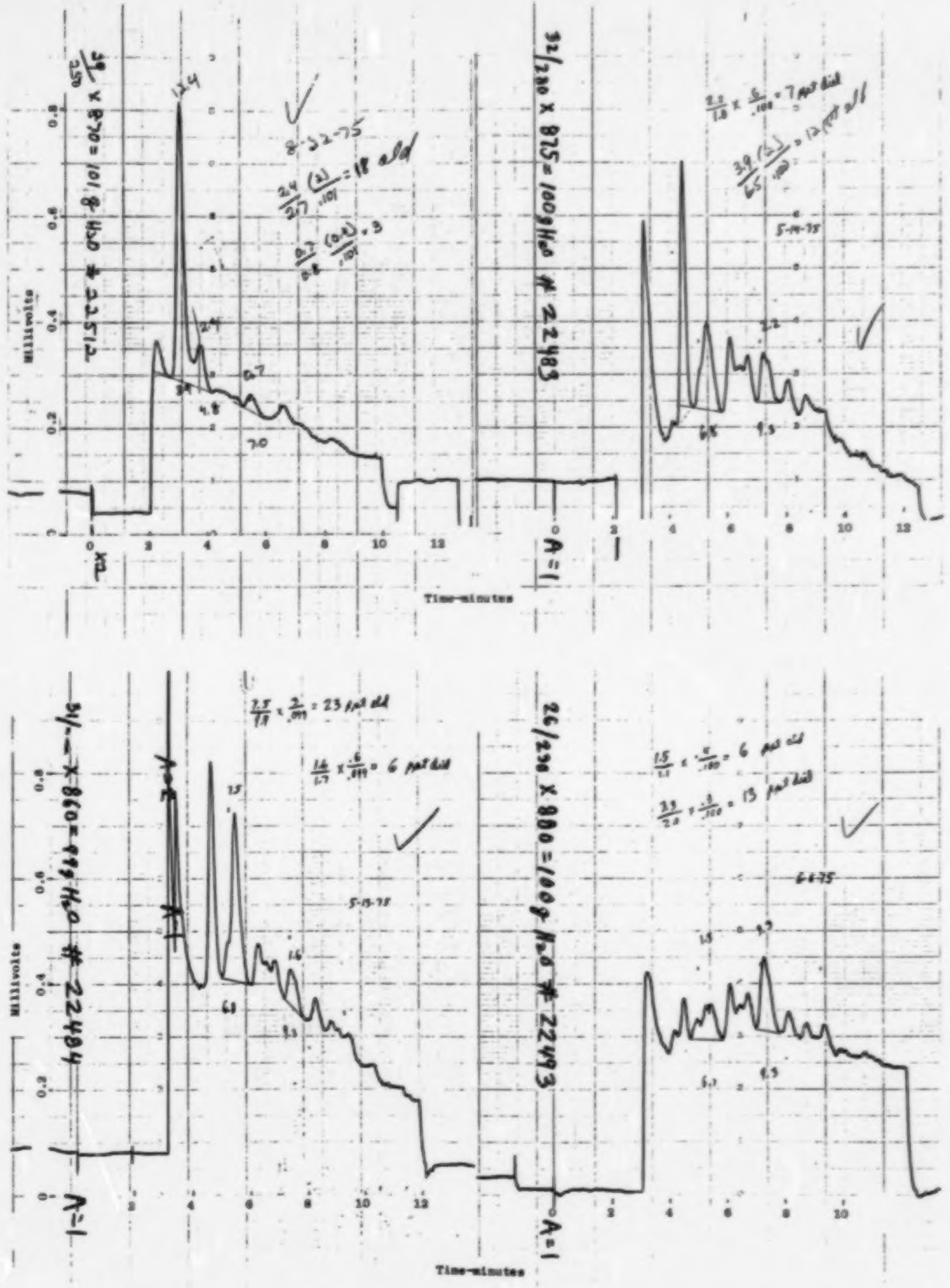


Figure 80 Sample Nos. 22512, 22483, 22484, 22493

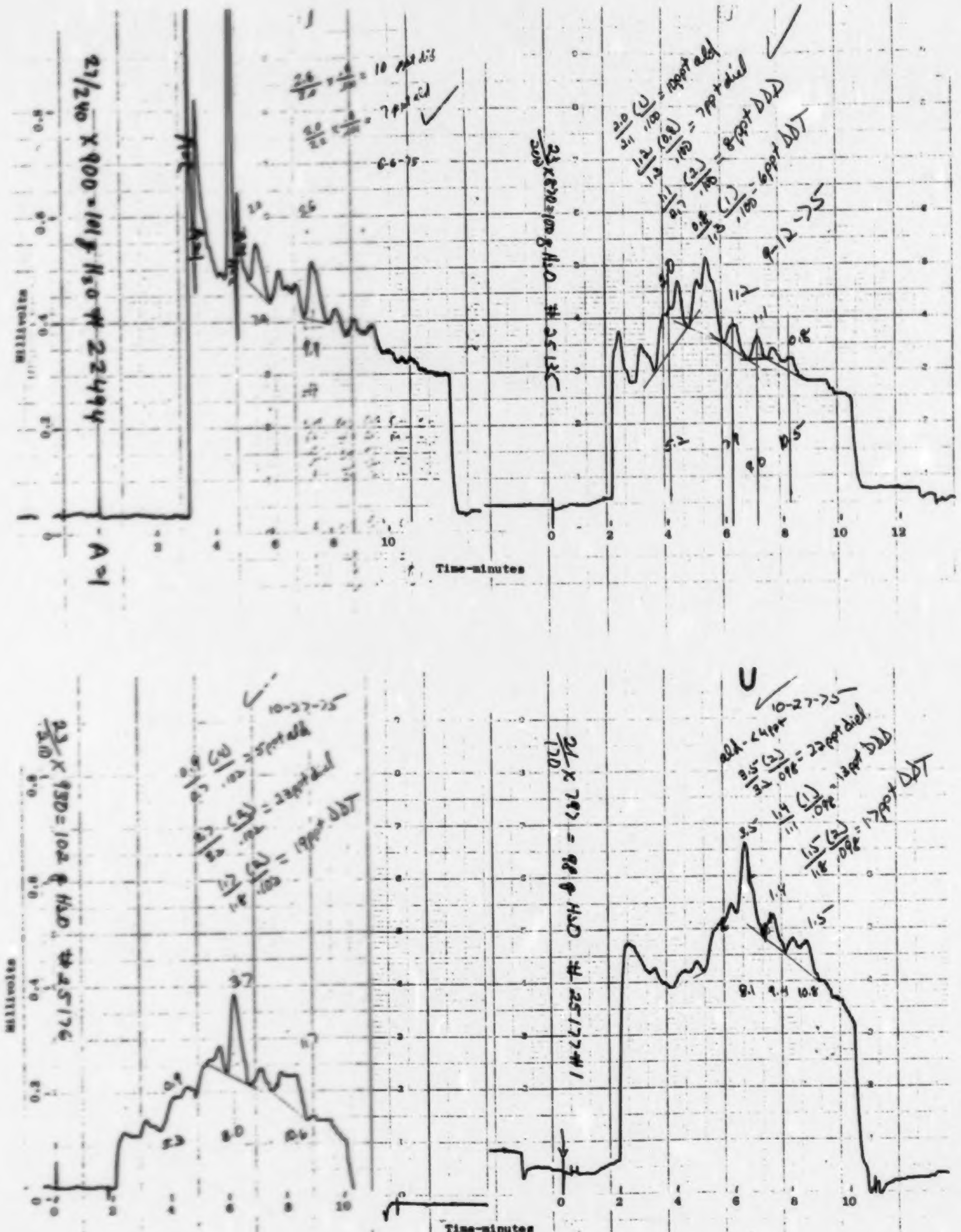
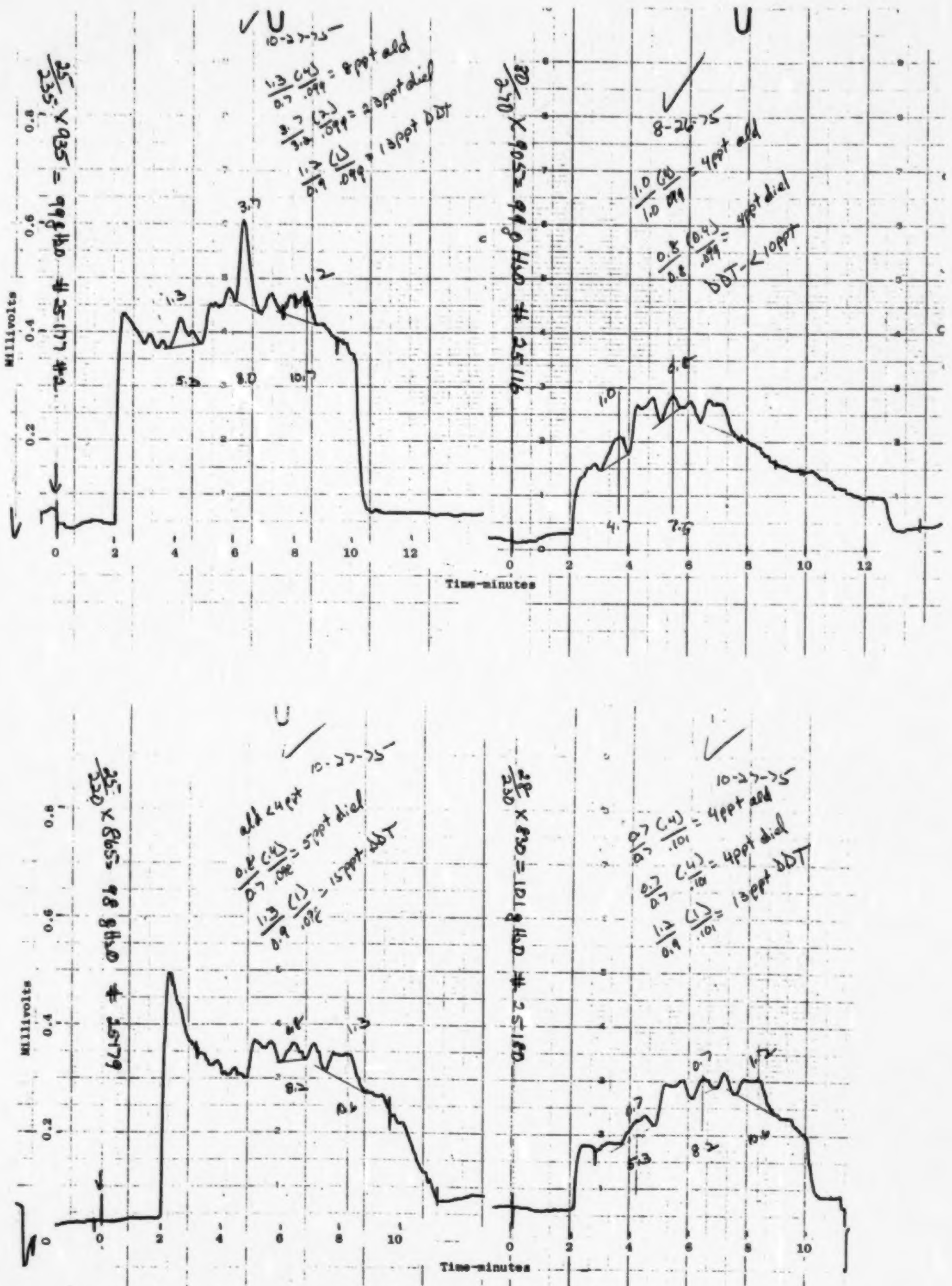


Figure 61 Sample Nos. 22494, 25135, 25176, 25177 (#1)



25/235 X 935 = 99 g H₂O # 25177 #2

10-27-75

1.3/0.7 (.4)/.099 = 8ppt ald

3.7/3.2 (.2)/.099 = 23ppt diel

1.2/0.9 (.1)/.099 = 13ppt DDT

30/270 X 905 = 94.0 g H₂O # 25116

8-26-75

1.0/1.0 (.4)/.099 = 4ppt ald

0.8/0.8 (0.4)/.099 = 4ppt diel

DDT - <10ppt

25/230 X 865 = 98 g H₂O # 25179

10-27-75

ald <4ppt

0.8/0.7 (.4)/.098 = 5ppt diel

1.3/0.9 (.1)/.098 = 15ppt DDT

25/230 X 930 = 101 g H₂O # 25180

10-27-75

0.7/0.7 (.4)/.101 = 4ppt ald

0.7/0.7 (.4)/.101 = 4ppt diel

1.2/0.9 (.1)/.101 = 13ppt DDT

Figure 82 Sample Nos. 25177 (#2), 25116, 25179, 25180

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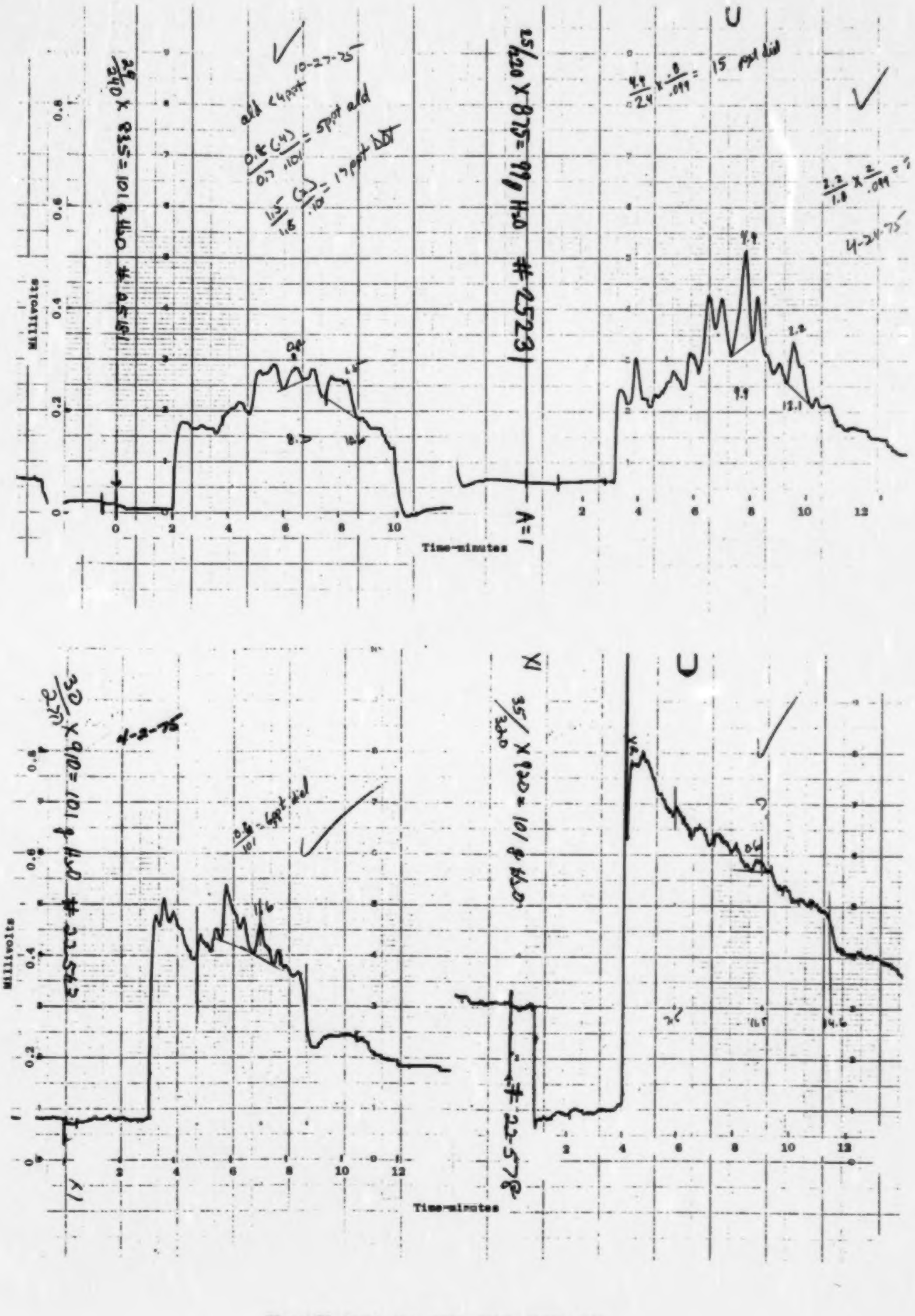

Figure 83 Sample Nos. 25181, 25231, 22563, 22578

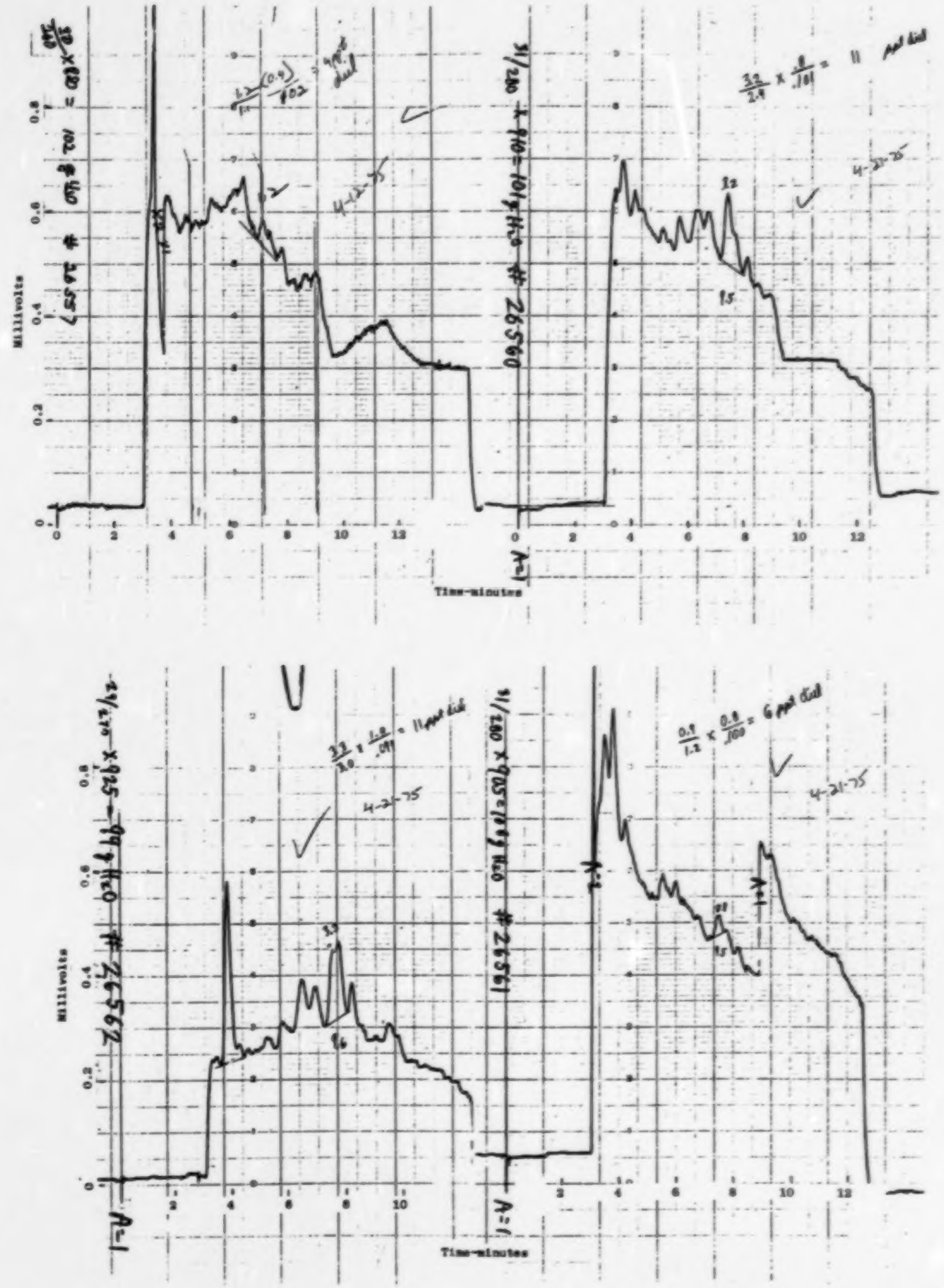

Figure 84 Sample Nos. 26557, 26560, 26562, 26561

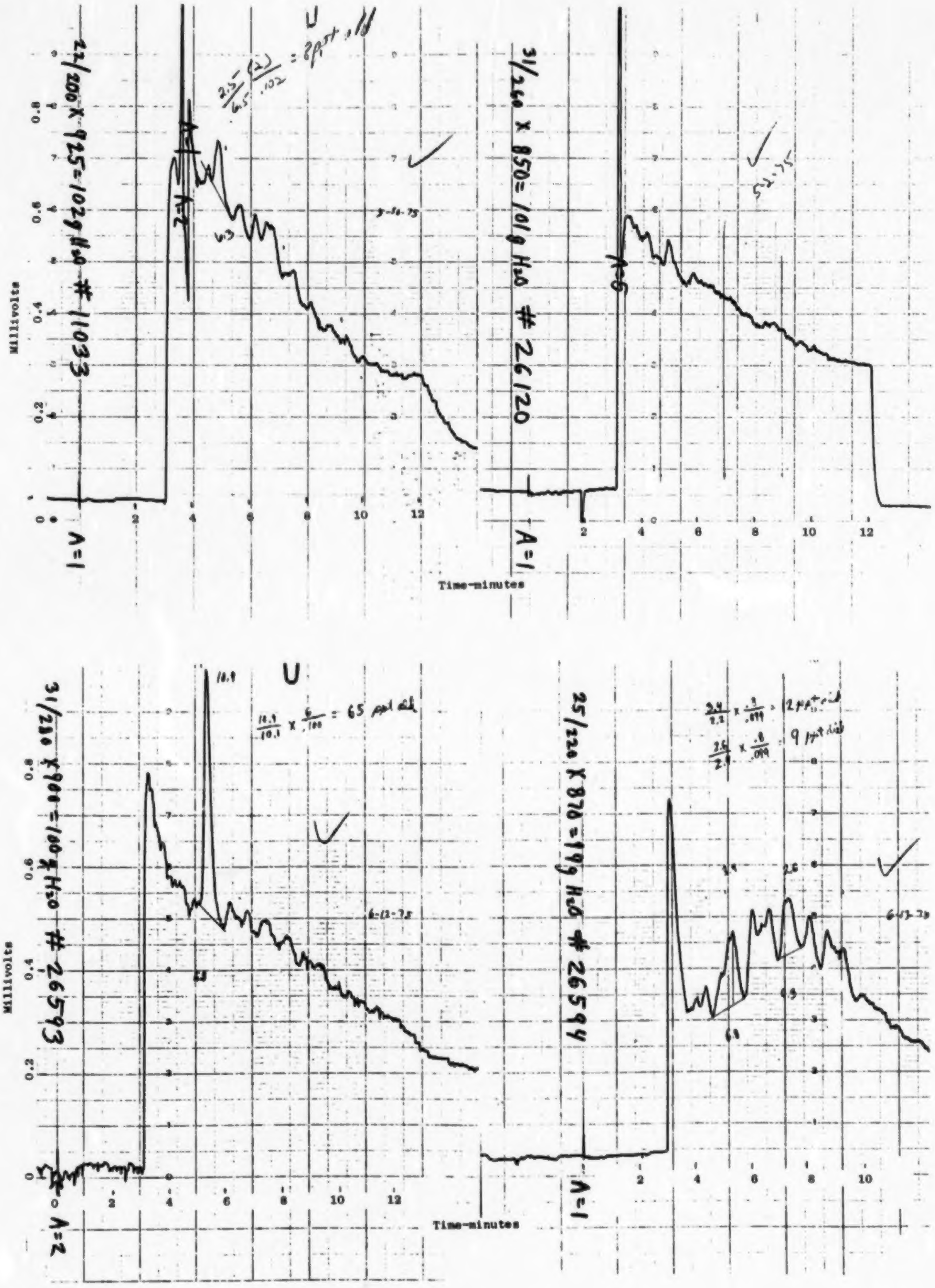

Figure 85 Sample Nos. 11033, 26120, 26593, 26594

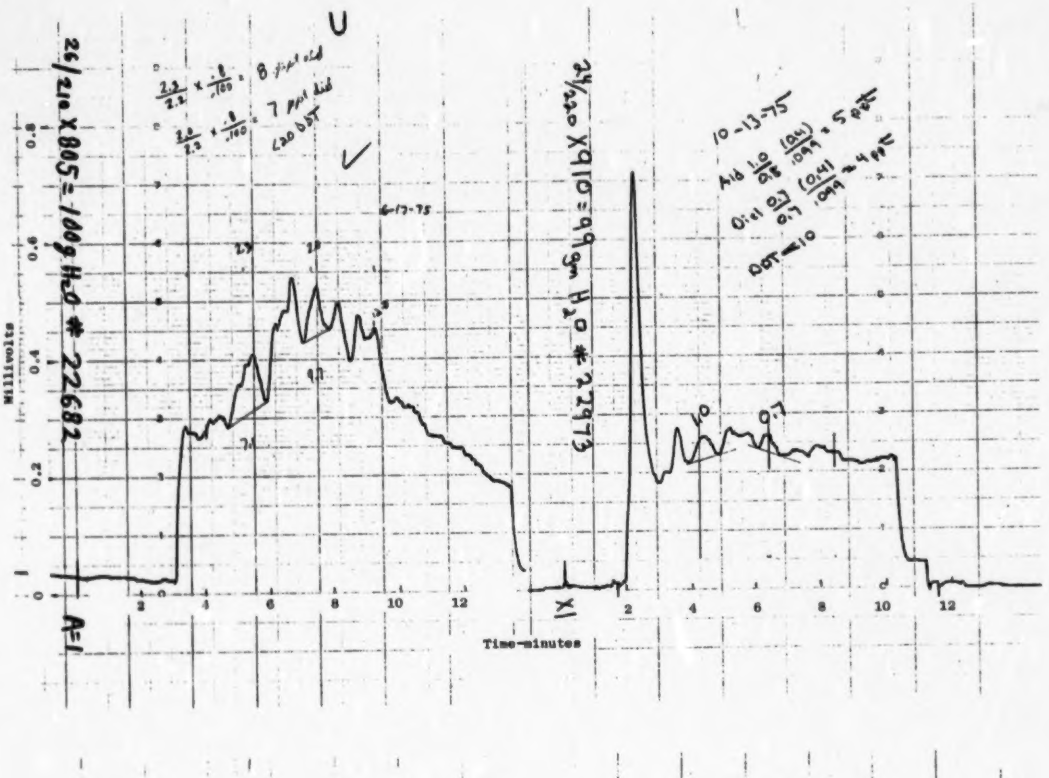

Figure 86 Sample Nos. 22682, 22973, 25132, 32932

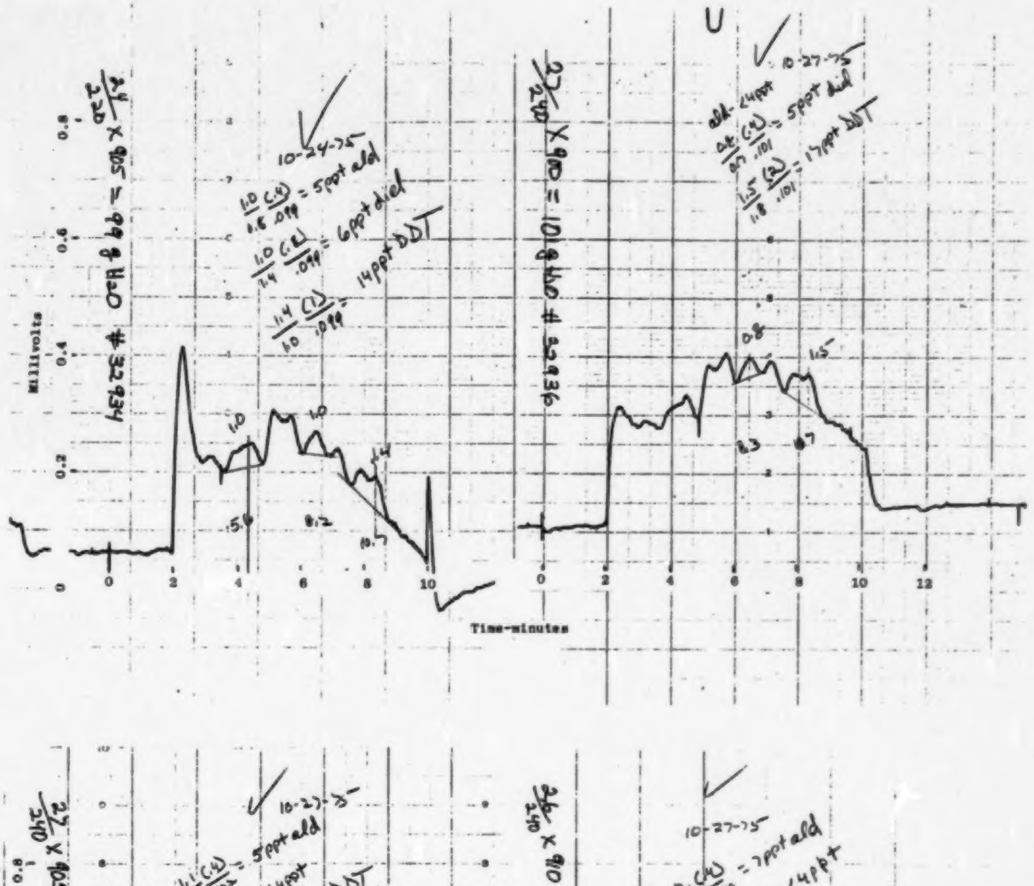

Figure 87 Sample Nos. 32934, 32936, 32937, 22972

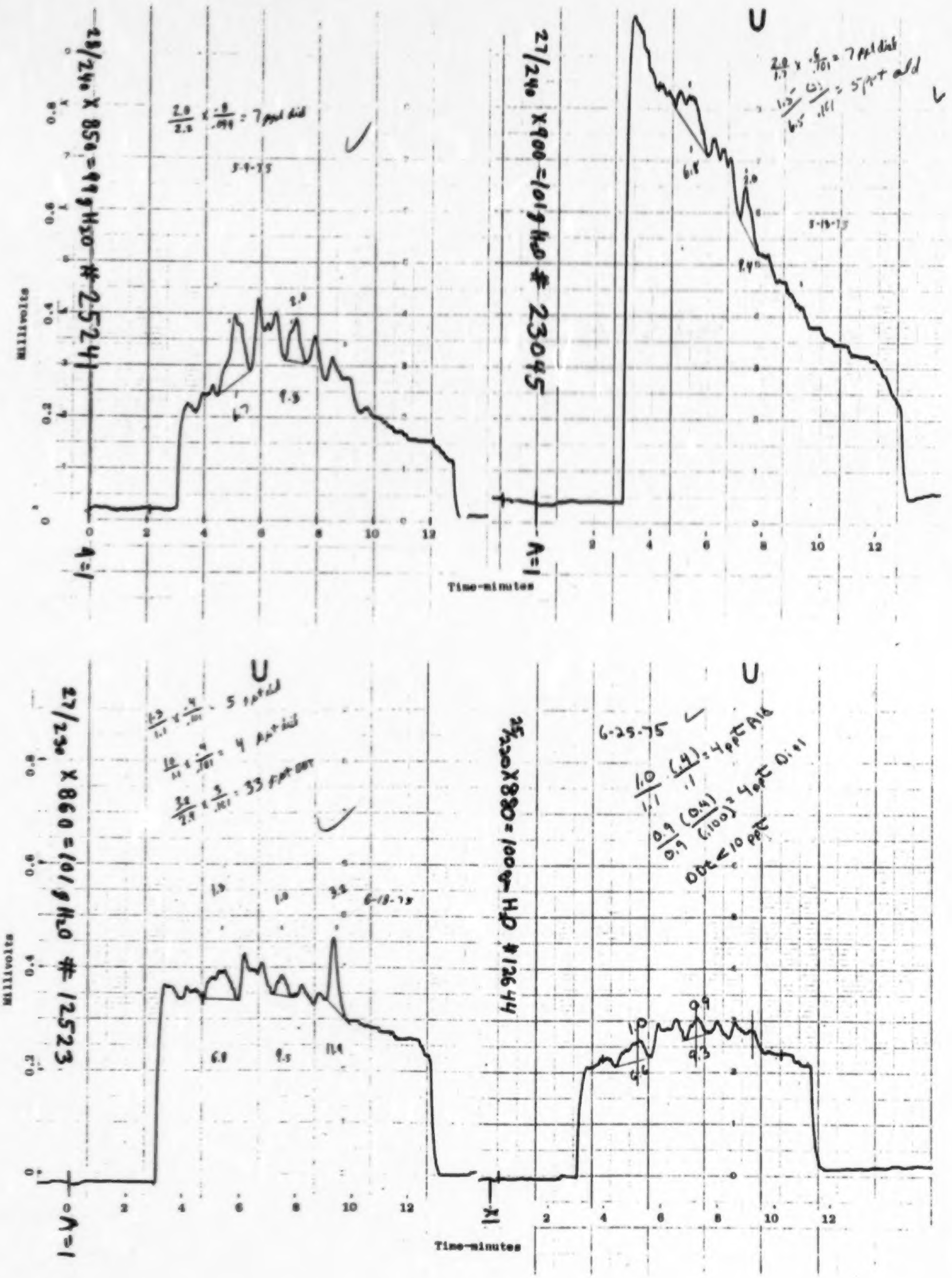

Figure 88 Sample Nos. 25241, 23045, 12523, 12644

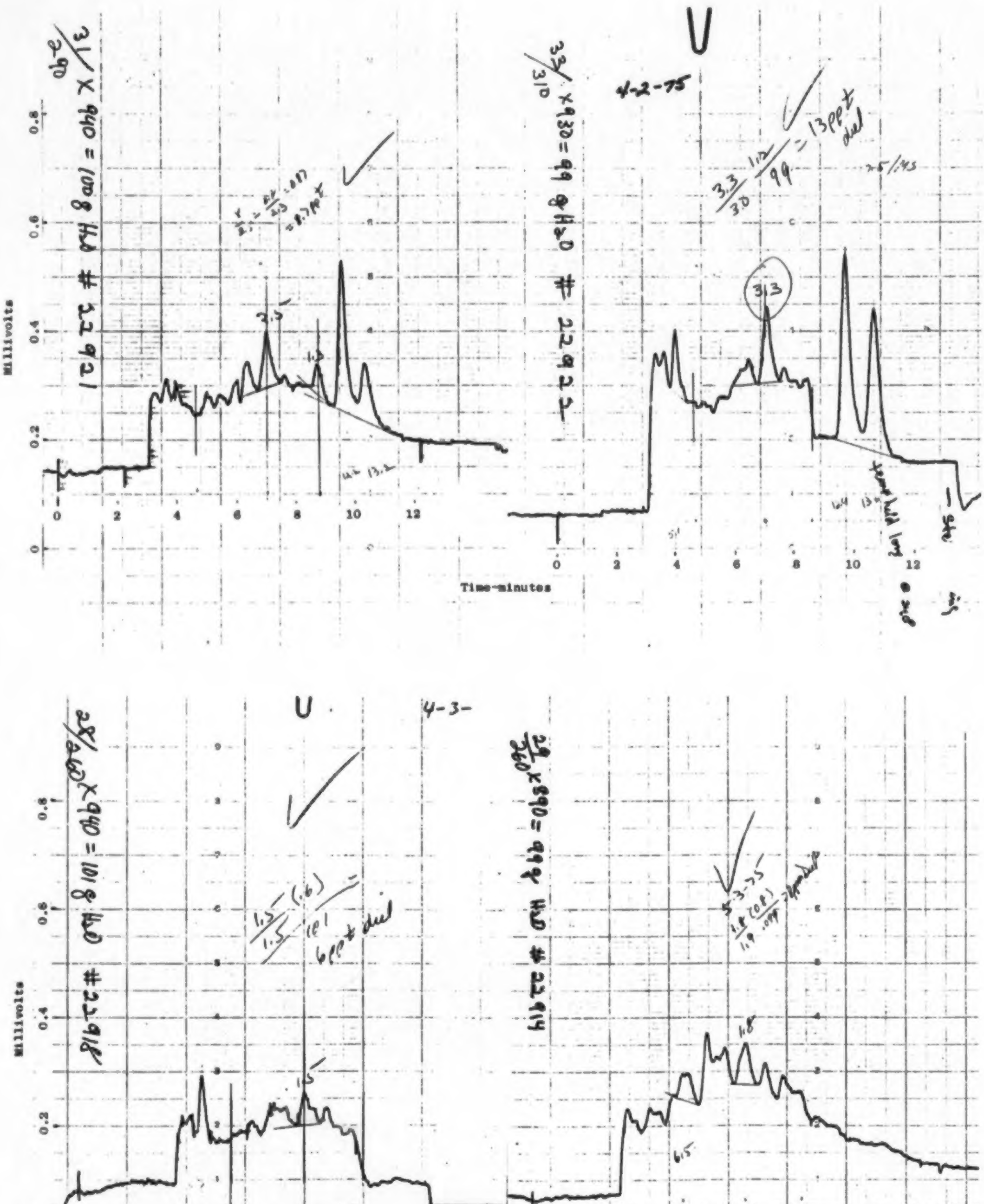

Figure 89 Sample Nos. 22921, 22922, 22918, 22914

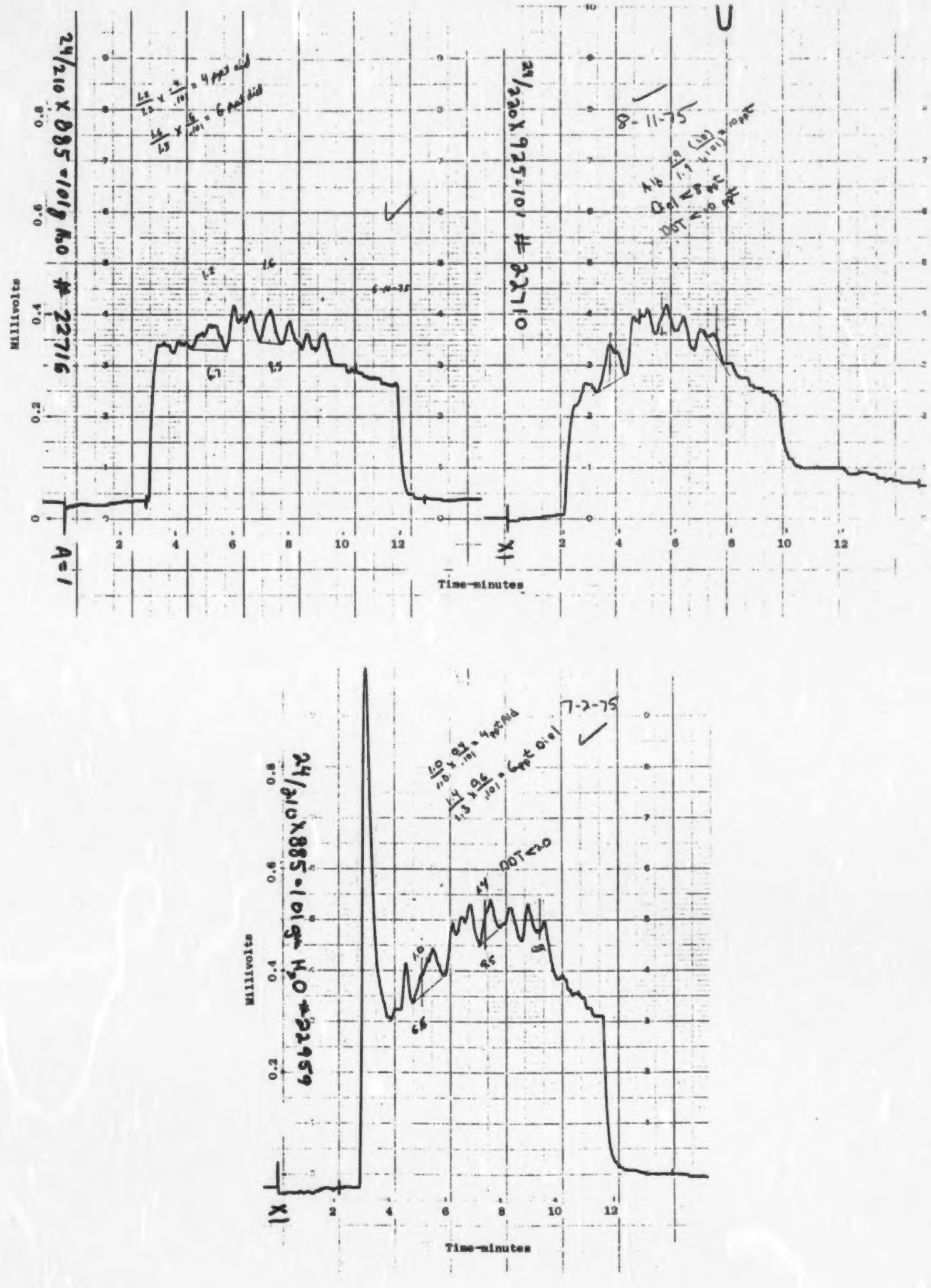

Figure 90 Sample Nos. 22716, 22710, 22959

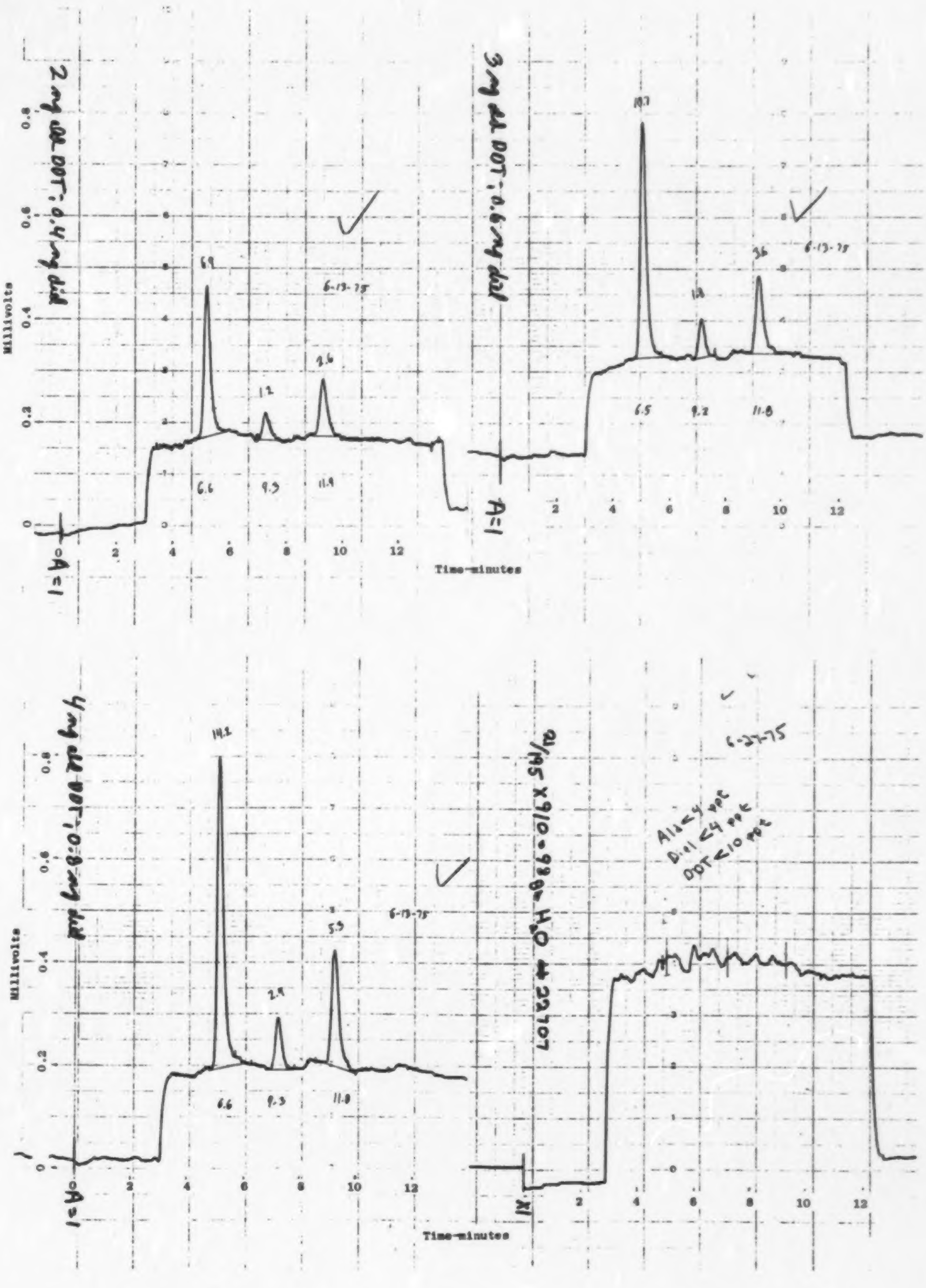

Figure 91 Aldrin, Dieldrin, and p,p'-DDT Standards; Sample No. 22707 (Blank)